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OBSERVATIONS REGARDING VENTRICULAR PUNCTURES

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VENTRICULAR punctures have been used in the diagnosis and treatment of internal hydrocephalus ever since the time of Hippocrates. The patients so treated were invariably young children of such an early age that the anterior fontanelle had not closed and the repeated ventricular punctures were made at the lateral angle of the open fontanelle so that the needle could be easily inserted into the greatly dilated lateral ventricle at a safe distance from the longitudinal sinus and without the necessity of making a bony opening. This method of treatment of internal hydrocephalus was naturally of little, if any, value, as it did not in any conceivable manner remove the cause of the blockage of the ventricles and therefore the blocked cerebrospinal fluid would again refill and dilate the ventricles, necessitating another tapping and so on until usually an infection and its resulting purulent meningitis would cause the death of the patient.

Combined Ventricular-lumbar Punctures.—Ventricular punctures have also been used diagnostically in recent years in cases of suspected internal hydrocephalus in order to inject into the lateral ventricle a small measured quantity of some harmless coloring substance, usually phenolsulphonaphthalein, and then to ascertain the time necessary for it to appear in the urine and the total amount so excreted; if no blockage of the ventricles was present, then the time of its appearance in the urine and its total amount would be within the normal limit of ten minutes, but if a complete blockage of the ventricles was present and since there is practically no absorption of cerebrospinal fluid in the ventricles, then little or no coloring substance would appear in the urine even within a period of one hour This test is by no means an accurate one as the ventricles themselves may not be blocked and yet the important excretory channels of the cerebrospinal fluid through the walls of the supracortical veins, through which over 80 per cent. of the cerebrospinal fluid is normally excreted, may themselves be blocked by the organization-residue of former meningeal exudate or of unabsorbed supracortical layer of hemorrhage and in this manner the appearance of the coloring substance in the urine may be long delayed and its quantity greatly reduced even to a degree of suggesting a partial blockage of the ventricles; in fact, many cranial operations have been devised and performed in the past to drain a supposed internal hydrocephalus when no such blockage existed, but rather an external hydrocephalus was present.

In order to facilitate the diagnosis in these cases, combined ventricular-

lumbar punctures were made by which a harmless coloring substance would be injected into the lateral ventricle and the time of its appearance in the lumbar spinal canal would be registered and also the total quantity so recovered; the normal time of its passage from the ventricles to the lumbar portion of the spinal canal was considered within three minutes. This method, however, merely demonstrated a ventricular blockage or not, so that usually the time of its appearance at the lumbar puncture needle was simply noted and if within normal limits showing that the ventricles were not blocked, then the lumbar puncture needle was immediately removed and the time of the appearance of the coloring substance in the urine and the amount of the total recovery were carefully noted in order to demonstrate the presence or not of an external hydrocephalus due to a blockage of the channels of excretion of the cerebrospinal fluid through the walls of the supracortical veins, sinuses, Pacchionian bodies, etc.

However, in this combined ventricular-lumbar puncture test, the presence or not of ventricular blockage was easily determined by placing the patient upon either side in a horizontal position with the spinal canal upon the same level plane as the median line or longitudinal sinus of the head; then, the patient being perfectly quiet, the pressure in the ventricle was accurately measured by connecting its needle with a manometer and then the pressure in the spinal canal was similarly obtained; in this manner, if the ventricles were blocked, then the ventricular pressure would ordinarily be higher than the spinal pressure and if not blocked, then both pressure readings should be the same. Another valuable observation could also be made: removing the stylet from each needle, the rate of flow or dropping of the cerebrospinal fluid should be the same if no blockage of the ventricles existed, and naturally if no blockage in the upper portion of the spinal canal was present which could be easily demonstrated by the Queckenstedt test (bilateral-jugular compression producing a normal rise of pressure at the lumbar puncture needle). If the ventricles were blocked, then the rate of flow of the cerebrospinal fluid from the ventricular needle would be just so much faster according to the degree of ventricular pressure and blockage.

Ventricular Estimations and Röntgenograms.—The above ventricular puncture tests are thus seen to have been limited almost entirely to the diagnosis and treatment of the condition of hydrocephalus and particularly in children in whom the dilated ventricles had enlarged the head, and it was not until Dandy in 1921 suggested the advisability of ventricular estimations and röntgenograms in the diagnosis and localization of gross lesions of the brain that any other use of ventricular tests was made. At times, in order to localize a doubtful brain tumor as being above or below the tentorium, then a ventricular puncture through the corpus callosum or into the lateral ventricles was performed in the past to ascertain the presence or not of ventricular dilatation: if present, then the tumor was most probably posterior basally or subtentorially in order that a blockage of the ventricles could result, but as a rule this preliminary test was rarely made as a subtentorial lesion usually disclosed its presence by the characteristic signs of cerebellar involve-

ment. (Fig. 1, a, b, c.) In the literature, there are several cases of air being reported as disclosed in the ventricles by röntgenograms following fractures of the skull, particularly those fractures in the frontal area through the ethmoidal cells or into the frontal sinuses, but no practical application was suggested by this phenomenon until Dandy presented his valuable contribution to this field of cerebral localization, in adults as well as in children.

In suspected cases of gross non-localized cerebral lesions that can be treated surgically, such as tumor and abscess formations, and the entire neurological armamentarium having been exhausted in efforts to localize the surgically removable lesion, then it is the opinion of this clinic that it is not only justifiable but obligatory upon the surgeon to use this method of ventricular estimations and röntgenograms in the hope that the cerebral lesion can be accurately localized and thus an opportunity be given to the patient of its successful removal. On the other hand, it is the opinion of this clinic that no

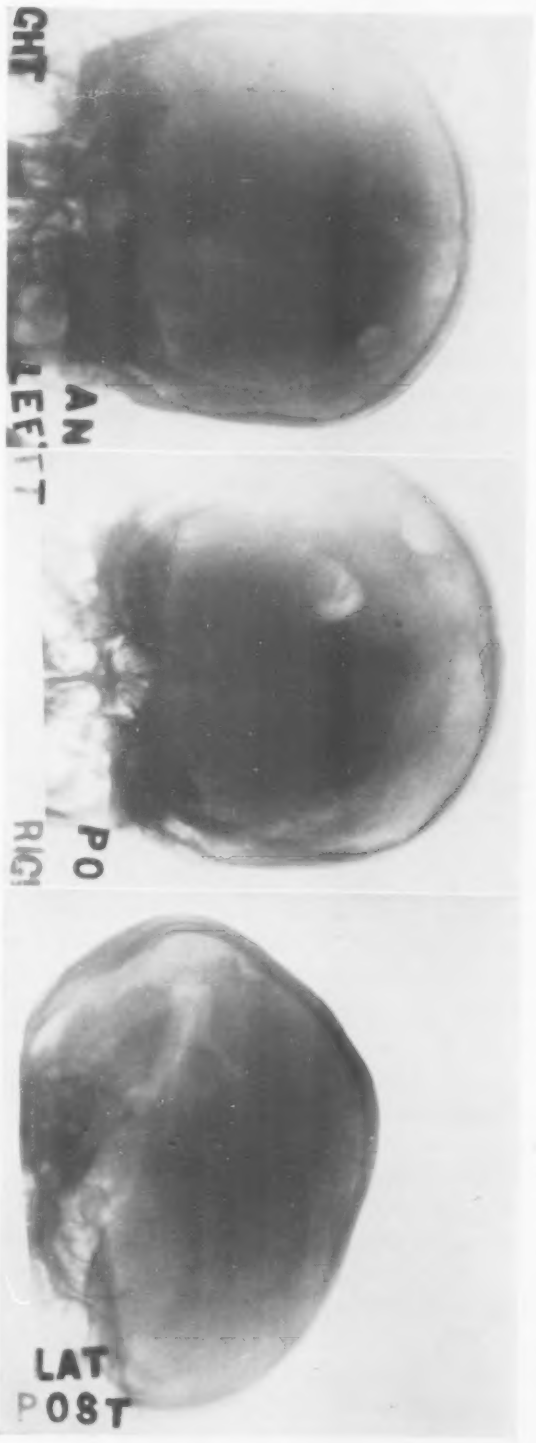

FIG. 1.

patient should be subjected to the permanent cerebral damage and its very possible future complications of cortical irritability and emotional instability, even to the degree of convulsive seizures, by the passage of the puncture needle through the cerebral tissues of the cortex into the ventricles, unless all neurological examinations and tests have failed to determine the localization of the lesion, and if the presence of a surgically removable lesion, such as tumor or abscess formation, is more than just a probable one. That is, to perform the ventricular estimations and röntgenograms as an early neurological examination without having exhausted every means to determine the cerebral localization, and especially the use of this test upon patients in the absence of a marked increase of the intracranial pressure and in whom the probability of a surgically removable lesion is very doubtful, and particularly in such patients already subject to convulsive seizures of cortical irritability—it is this careless and indiscriminate use of ventricular estimations that is not only dangerous to future normality of these patients, but it tends to discredit legitimate use of a most valuable test in *selected* cases.

Besides the immediate cerebral damage incidental to the ventricular puncture by the blunt trochar as it penetrates the occipital lobe toward and into the posterior horn of the lateral ventricle—and this cellular damage of brain tissue is not merely a possibility or a theoretical one, but *occurs each time this test is made*, and especially so when several cortical punctures are frequently necessary in order to locate the ventricle, and even though its signs may not appear clinically until weeks or months later, there is also a reported mortality from the test itself from various clinics of almost 10 per cent.; in this clinic the mortality following the test has been 8.4 per cent. This mortality, however, should become lower as greater care is taken to avoid sudden marked changes in the ventricular pressure by the withdrawal at any one time of only a small amount of ventricular cerebrospinal fluid—not over 5 c.c., and by its immediate replacement with an equal amount of air until the usual amount of 15–20 c.c. of air has replaced an equal amount of cerebrospinal fluid and not under a higher pressure than was originally present in the ventricles; in this manner, no sudden change of the ventricular pressure has occurred and thus is lessened the great danger of hemorrhage into a large tumor mass from its poorly supported and often diseased blood-vessels, or of precipitating an acute cerebral and then medullary œdema following a marked change in a high intracranial pressure, to which the intracranial vascular system had accustomed and slowly adjusted itself over a period of months during the growth of the tumor or abscess formation. In three of the cases in this series at necropsy, two disclosed a large hemorrhage of almost the size of an orange in extensive gliomatous tumors and neoplasms were situated in the right frontal area far from the ventricular puncture which was performed into the posterior horn of the left ventricle, and the remaining one disclosed an acute cerebral and resulting medullary œdema in the case of a large endothelioma in the right temporosphenoidal lobe.

In six patients from whom at later operation large cerebral tumors were removed in whole or in part, within twenty-four hours following the ven-

tricular estimations and röntgenograms occurred a marked increase of the intracranial pressure to a degree that retinal hemorrhages appeared as the œdematous swelling of the optic disks became greater with an associated severe headache; in three of these patients, drowsiness to even stupor persisted for forty-eight hours and then gradually subsided as the acute cerebral

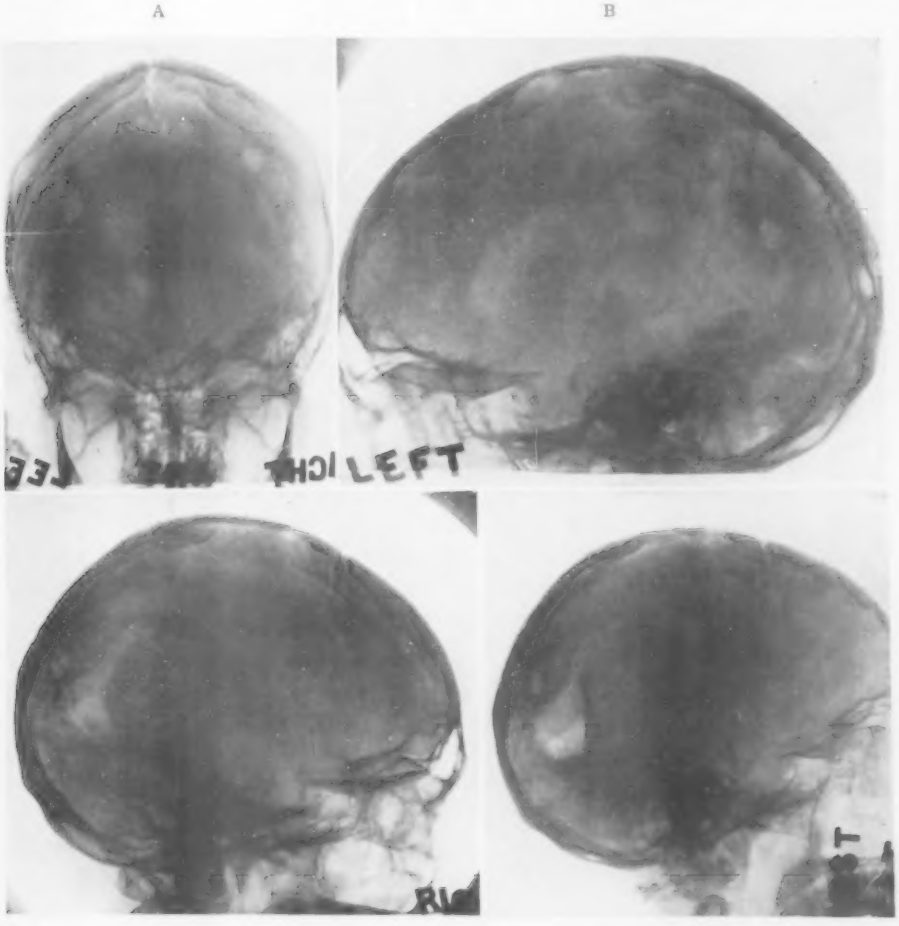

FIG. 2.

œdema resulting from the cerebral punctures themselves or from the alteration of the ventricular pressure lessened in severity. (Fig. 2, a, b, c, d.)

Naturally, in the absence of large intracranial lesions producing a high intracranial pressure and in the presence of only a slight ventricular blockage and dilatation, then the immediate risk of life of ventricular estimations and röntgenograms is a slight one, as the resulting alterations of intracranial pressure due to the test would necessarily be little, if any. This observation applies equally to those suspected and doubtful cases of surgically removable lesions and yet no such lesion is demonstrated by the test or even at later exploratory operation; however, these latter patients are just the ones upon whom the test should rarely if ever be performed as there is no definite increase in the

intracranial pressure, and it is the performance of the test upon these non-surgical cases in those clinics that report such a low mortality—one or two per cent. and even no mortality! It would indeed be interesting to ascertain the statistics in these clinics of the end results of all their patients subjected to ventricular estimations and röntgenograms and thus to realize the low percentage of surgically removable lesions in these patients. To perform this serious test, fraught with danger to life as well as to future normality, upon patients and no lesion amenable to surgical treatment is found, then the patient, to say the least, has not been benefitted by the procedure and such operative tests merely tend to discredit the rational use of a most valuable aid in the diagnosis and localization of selected surgically removable lesions. Cerebral tissues can in no way be compared with liver or muscle tissue or with the tissues of the chest or abdominal wall, and although such puncturing of cerebral tissues causes permanent damage that may not be evident by clinical tests, yet the emotional reactions and the personality of the patient may be gravely altered. Surely if the patient cannot be benefitted by surgical procedures, then at least no examinations and no tests should be employed that may make the condition of the patient worse. These so-called doubtful cases are just the ones in whom repeated attempts to utilize injection of air for ventricular and supracortical röntgenograms by means of lumbar puncture route with patient in sitting position or by cisterna magna route would be eminently justified; patient would at least not be damaged by the tests and when this method is successful in permitting injected air to pass into ventricles or over cortex, then the röntgenograms are equally satisfactory.

In one clinic, essential or so-called idiopathic epilepsy is apparently considered amenable to cranial surgery and upon these sufferers of a cellular degenerative process, this test of ventricular estimations and röntgenograms is performed as a part of the routine neurological examinations, and if there be either a so-called ventricular "hypotension" or even a mild ventricular hypertension—so often associated with the "wet" cerebral œdemas resulting from and secondary to the convulsive seizures themselves, then an osteoplastic "flap" operation is performed to alter such ventricular variation of pressure! To insert a ventricular trochar through brain tissue already in such an irritable condition as to permit convulsive seizures to occur and then to believe that any cranial and cerebral operative procedure can in any conceivable manner permanently affect the degenerative cellular process—such an attitude is, at best, a metaphysical one, and if such a practice should become a general one, then neurosurgery would be rightly classed with the discarded specialties of alchemy and astrology.

The rational use of the test of ventricular estimations and röntgenograms makes possible the accurate localization of many cerebral tumors and even cerebral abscesses in selected cases that otherwise could not be determined except by means of an exploratory operation, if even then successful. The majority of gross cerebral lesions can be definitely localized by the usual neurological examinations and these are the patients that should not be subjected to the additional cerebral trauma of ventricular punctures; but there is

a small percentage of patients having intracranial lesions amenable to surgical treatment that cannot be localized with any degree of accuracy even after repeated and most careful neurological examinations, and these are the patients and only the ones that should be given the opportunity of having the lesion definitely outlined by means of ventricular röntgenograms. It must be remembered, however, that even this method of ventricular diagnosis often fails to indicate the site of the tumor—especially the presence of small tumor formations in or protruding into the cerebral cortex and particularly is this more frequent in either frontal or temporosphenoidal lobe—the comparatively silent areas of the brain in the right hemisphere in right-handed patients. It is indeed surprising, however, to note the slight dislocation of the lateral ventricles to or from the median line, and forward, backward, upward or downward, even in the presence of an apparently small cortical tumor of the infiltrating gliomatous type, and also the definite indentation and even constriction of the adjacent horn of the ventricle in the presence of small tumors causing an indirect rather than a direct ventricular pressure. It is even possible to have a mild degree of bilateral ventricular dilatation in presence of small frontal tumor due most probably to associated cerebral œdema causing downward pressure upon brain stem sufficient to block normal escape of cerebrospinal fluid through aqueduct of Sylvius or more probably from foramina of Majendie and Luschka of fourth ventricle.

Yet the careful study and correct interpretation of the ventricular röntgenograms will make possible the accurate localization of many surgically removable lesions of the brain that otherwise might be overlooked entirely even after several exploratory operations, and therefore this notable contribution by Dandy marks another epoch in the advance of neurosurgery. It is being more and more realized, however, that ventricular estimations and röntgenograms will not aid in all cases of unlocalized tumor and abscess formations, and that the test should be performed only in selected cases necessitating its use; that practically four-fifths of brain tumors are malignant in that they recur even after their successful removal and that the operative mortality of true brain abscess within cerebral or cerebellar tissue is still almost 70 per cent., even when localized comparatively early! In this connection, it is important to emphasize the necessity of great care in advising and in performing the ventricular estimations and röntgenograms in the presence of a possible meningitis or meningoencephalitis; to make the ventricular punctures through the cerebral cortex in the hope of localizing the abscess formation and there is present a meningeal inflammatory process so frequently co-existent with it, then the danger of producing a purulent encephalitis and multiple brain abscesses is very great indeed; also the wet œdematous brain associated with encephalitis and so often mistaken for cerebral tumor that the condition is known as one of "pseudo-tumor"—to perform a ventricular puncture on these patients merely increases both the cerebral œdema and the great danger of an extension of the cortical process to the deeper subcortical tissues—and with no benefit to the patients, to say the least.

SPONGIOBLASTOMA MULTIFORME OF THE BRAIN

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Virchow [1] was perhaps the first to identify a large group of intracranial tumors which have their origin from the glial tissue of the brain. He described such neoplasms as slow-growing, infiltrating, vascular masses which are prone to contain hemorrhages, cysts and large areas of degeneration. He

Fig. 1.—Coronal section of brain showing extensive cystic and hemorrhagic degeneration in the tumor which practically replaced the cortical tissue.

gave the name *glioma* to these new growths. At present such tumors are considered to be of ectodermal origin and to consist of glial cells and extracellular fibres. They are said to be found only in the central nervous system and its outgrowths, such as the retina.

Until recently, the rather inclusive and ill-defined term *glioma* has been given to all intracranial tumors to which Virchow's description applied. It may be realized how large a group of neoplasms came under this heading when it is remembered that gliomas constitute about forty per cent. of all intracranial new growths. That many of these tumors exhibit a gross pathological appearance and a clinical course which are entirely different from those of other growths in the same category had been recognized by many neurologic surgeons. It has remained for Cushing and Bailey,[2] however, to furnish a microscopical differentiation which may be correlated with the clinical course of the lesion. This has been done by the application of many of the gold and silver staining methods developed by Cajal and his school.

Such a study has furnished a means of reclassifying and subdividing the large number of gliomas into smaller groups, each with its characteristic gross pathological, microscopical and clinical picture. That such a reidentification should have for its basic principle the normal histogenesis of the brain seems only logical and natural. It has allowed these authors to identify in Cushing's series of intracranial tumors practically every cellular type found in the development of the central nervous system. Their work has afforded a definite and invaluable step forward in the surgical treatment of this large group of tumors of glial origin.

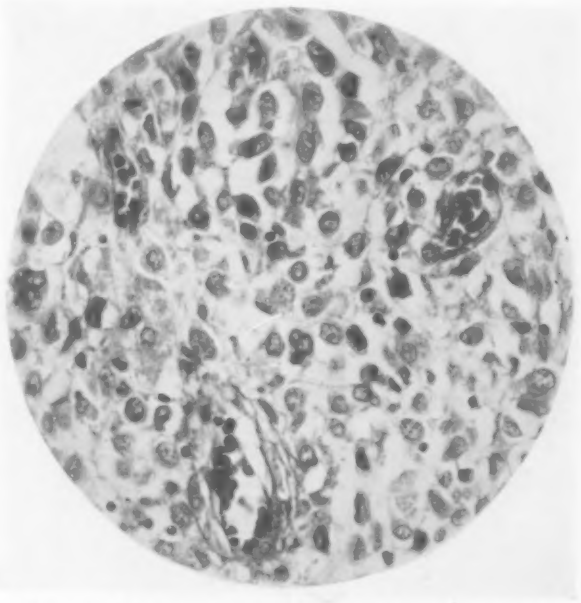

FIG. 2.—Section of tumor mass removed from brain. Blood-vessels show proliferation of endothelium and tumor cells appear to invade lumen. Alzheimer stain x 380.

It will be remembered that the medullary plate, from which the central nervous system develops, consists primarily of one layer of columnar epithelial cells known as the medullary epithelium. From this layer three types of cells may develop: (1) primitive spongioblasts, (2) medulloblasts or indifferent cells and (3) neuroblasts. The *primitive spongioblast*, in the course of its normal development, passes through a bipolar and unipolar stage to the astroblast which is the immediate forerunner of the adult fibrillary and protoplasmic astrocyte. The *medulloblast* or indifferent cell, as its name implies, has no prescribed line of development but may become either a glia or a nerve cell. The *neuroblast* passes through a series of stages like the spongioblast and eventually forms the adult nerve cell. As stated before, Cushing and Bailey have identified tumors arising from these cells in practically every stage of their development.

Globus and Strauss [3] and later Ribbert [4] proposed the name *spongioblastoma* for a large group of tumors whose cells are of neuroglial origin, and the qualifying adjective *multiforme* because their striking feature is their multiform appearance. Many of the cells are multinucleated and represent true giant cells. The amount of cytoplasm varies greatly while the nuclei are of various sizes and shapes and contain a variable amount of chromatin. In Cushing's large series of intracranial neoplasms the spongioblastoma multiforme was found most often.

It is known that some of these neuroglial tumors may be accompanied by multiple primary growth centres situated at some distance from one another within the brain. It is recognized also that the medulloblastoma may become disseminated through the subarachnoid spaces where, upon implantation, it loses its original characteristics. It is questionable, however, whether either of these processes constitute what is recognized as metastatic growth. That carcinoma of many viscera commonly metastasize to the central nervous system is well known, but a metastatic growth formed from a primary focus in the brain and situated at a distance and within fundamentally different tissue is a pathological entity which assumes clinical importance because of its rarity.

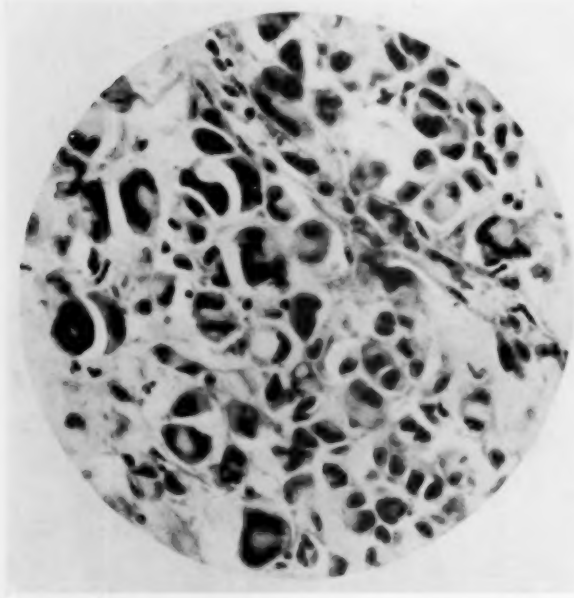

FIG. 3.—Section of tumor mass from brain showing multinucleated cells and division of cells. Mallory phosphotungstic acid-hematoxylin stain x 380.

Such an instance was met during the clinical course of the patient whose history is given in abstract:

Rapid onset of intracranial symptoms. Operation and removal of an apparently enucleable tumor from the left temporal lobe. Improvement in the symptoms. X-ray therapy. Progression of the symptoms. Second operation with removal of eighty grams of tumor tissue. Death three months later. Necropsy. Spongioblastoma multiforme with metastases in the right arm, left lung and the soft tissues over the right scapula and the left costal margin.

History.—K. K., aged thirty-one years, was referred by Dr. H. A. Richter, of Evanston, Illinois, and entered Wesley Memorial Hospital on January 10, 1926.

The patient was a concert pianist and felt quite well until October, 1925. She then noticed that she was playing the piano poorly because she could not take in a large sweep of notes at one glance. This made her playing uneven, irregular and choppy. In order to read ahead, it became necessary for her to turn her head in short movements to the right. After a time, which was very indefinite in her mind, she noted that she had diplopia. The false image alternately faded away and came back into her field of vision. Soon she developed a frontal headache which was very marked and was accompanied by vomiting.

These events occurred between October and December 25, 1925. She then was fitted for glasses, but three changes of lenses failed to give relief. About January 1, 1926, she first noted difficulty in saying words and in completely verbalizing her train of thought.

Examination.—There was a high degree of papillœdema in both fundi, and both blind spots were greatly enlarged. A right homonymous hemianopsia was quite evident. This was complete to the median line. There were never any hallucinations of light or

form in either the hemianopic or normal field. There was weakness of the left external rectus muscle and a ptosis of the left upper eyelid. There was no weakness of the right arm or leg and no sensory changes over the body. The patient had an incomplete verbal, nominal and semantic aphasia.

Course.—On January 14, 1926, an osteoplastic flap was made to expose the left temporal and parietal lobes and the posterior portion of the frontal lobe. A circumscribed tumor mass was found to occupy the posterior portion of the superior and middle temporal convolutions and the inferior portion of the parietal lobe. This was two centimetres beneath the surface of the cortex. The mass was separated from the surrounding cortical tissue by moist cotton pledget dissection. The portion of the tumor delivered was about the size of a large hen's egg. At its base the line of demarcation became indistinct and this edge of the mass removed was irregular. The remaining cavity was treated with Zenker's solution. A decompression opening was left in the flap which was replaced.

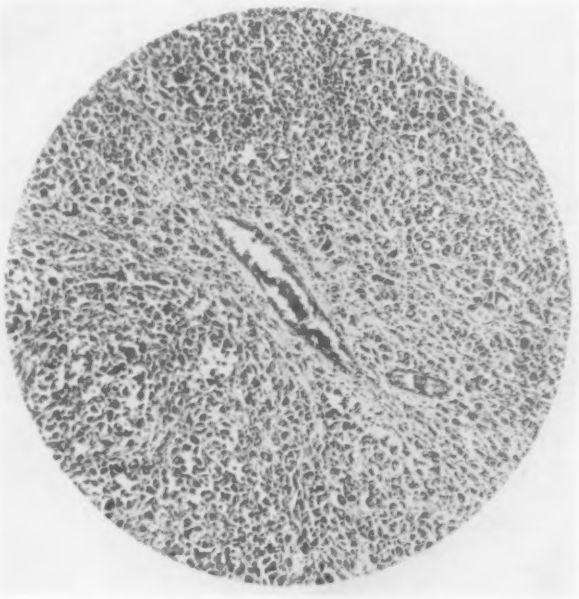

FIG. 4.—Tumor mass removed from soft tissue of right arm. Hematoxylin-eosin stain x 80.

The patient did well although her aphasia increased and her hemianopsia remained as complete. She went home on February 9, 1926. On February 15, she complained of stiffness in her right arm and leg, and her aphasia was increasing. She returned to the hospital on March 11, and upon five successive days received deep X-ray therapy over the area of the decompression and osteoplastic flap.

Following this, the decompression area began to herniate and by March 19 had assumed enormous proportions. I then reëlevated the bone flap and found that the tumor mass occupied the entire field. I removed about eighty grams of tumor tissue and replaced the flap without the bone. The patient's speech then became better and she became able to walk, although with a marked hemiplegic gait. She returned home on March 31, 1926. Her subsequent course from this time until May 17 was irregular, but on the whole she was comfortable and her condition did not become worse. On May 17 she suddenly developed a tremendous and acute increase in intracranial pressure and was returned to the hospital. The intravenous administration of hypertonic glucose solution gave immediate relief. Examination at this time revealed a tumor mass about the size of an English walnut over the posterior aspect of the right arm. This was firm, circumscribed and not painful. The aphasia and hemiplegia were unchanged. The herniation through the decompression area was quite large and was evidently a tumor mass. The patient again returned home on May 23.

On June 2, she returned to the hospital. She was then obviously failing rapidly. Hypertonic solutions were without effect. The mass over her right arm had grown to the size of a small orange, but was still circumscribed. The skin over it was not movable and was quite red. A small marble-sized tumor was found in the left axilla. On

June 15, a small mass exactly similar to those described was found over the eleventh rib anteriorly. It seemed to lie just beneath the skin. On June 18, a nodule was found in the substance of the right pectoral muscle. Exitus occurred July 20, 1926.

Necropsy.—There was a firm, movable, dark purplish mass in the soft tissues of the posterior surface of the right arm which measured 7 cm. in diameter. Another small firm nodular mass 1 cm. in diameter was present over the right scapula, and another 1.5 cm. in diameter at the left lower costal margin.

On the lateral surface of the lower lobe of the left lung were two small firm nodules measuring from 2 to 5 mm. in diameter. Another nodule 1.5 cm. in diameter was present in the centre of the upper lobe of the left lung. On section these nodules were flesh-like and slightly gray. No masses were found in the right lung.

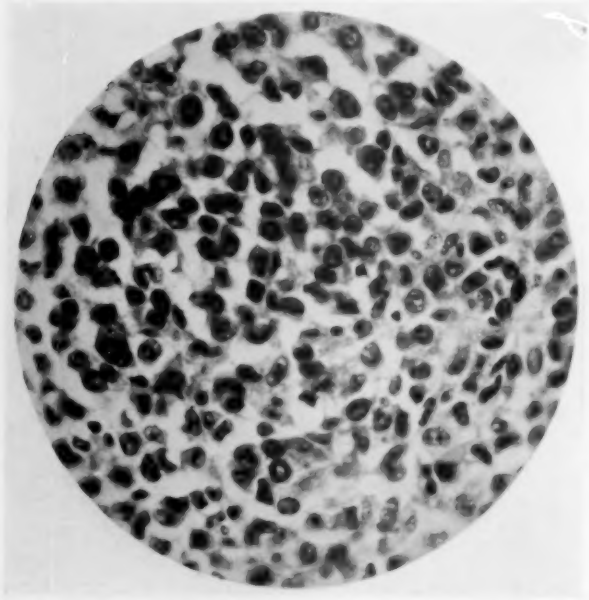

FIG. 5.—Section of tumor mass taken from soft tissues of right arm shows multinucleated cells similar to those found in the neoplasm of the brain. Hematoxylin-eosin stain x 380.

Upon fixation and removal, the brain showed a tumor mass which projected from the lateral surface of the left cerebral hemisphere. This was spheroidal and measured 15 cm. in diameter. It was composed of lobulated masses with numerous cystic and degenerated areas (Fig. 1). The opposite hemisphere was symmetrically shaped and showed no tumor masses.

Microscopic Anatomy.—A microscopic section of the neoplasm in the brain is made up chiefly of large glial cells which resemble the pyriform cells described by Globus and Strauss in cases of spongioblastoma multiforme. Many giant cells are present. The nuclei have bizarre shapes and seem to be dividing directly. No mitotic figures are present, although the unusual shapes of the nuclei give the appearance of mitosis. The cytoplasm is voluminous and stains opaquely. The lumen of many of the blood-vessels in the tumor tissue is closed by a proliferation of endothelial cells. The neoplasm appears to invade these hypertrophied vessels, but tumor cells are not found within the lumen of the vessels. There is a tendency for the cells to form a pseudo-palisade about the vessels. No nerve cells are found, and there is no tendency for the cells to develop into astrocytes.

The cells of the growths in the lung and in the soft tissues of the arm and back are similar in all respects to those found in the cerebral neoplasm. In these instances, however, the cells infiltrate fibrous connective tissue. Moreover there is no endothelial proliferation in the vessels such as is seen in the brain tumor. The similarity of the microscopic picture leaves little doubt that these tumors are metastases from the spongioblastoma multiforme of the brain (Figs. 2, 3, 4, 5, 6).

Dr. Wilder Penfield, of New York City, was kind enough to examine sections of the brain tumor and the metastases. His diagnosis was spongioblastoma multiforme. He adds, "There is one thing which is absent in this tumor which is found in most spongioblastomas, that is, the numerous small nuclei in cells with a scanty cytoplasm which I

have always considered to represent the spongioblast. In one or two areas of this tumor there are collections of these smaller cells but they are nearly altogether absent. Multiplication has taken place along the pyriform and giant cells."

Comment.—The tumors classified as spongioblastoma multiforme are the most common of the cerebral neoplasms. The unusual point of clinical interest in this instance is the occurrence of metastases at a distance in tissues embryologically distinct from the nervous system. Such metastases are so uncommon as to make them a rarity. The opposite process of metastasis from other viscera to the brain is not infrequent and has been well described by Grant,[5] Hassin [6] and many others.

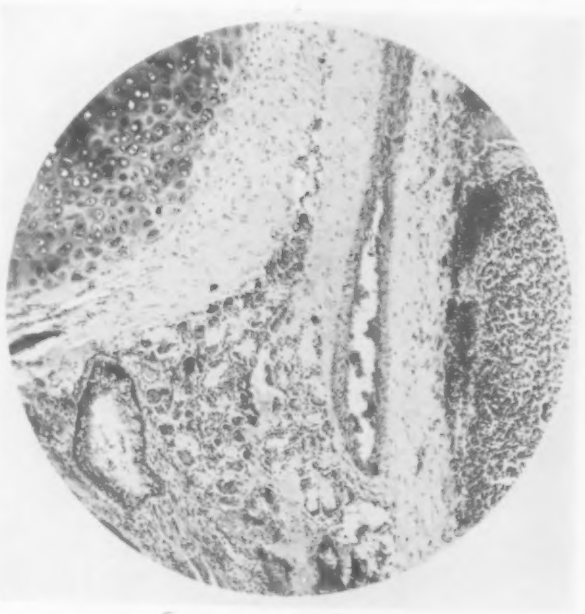

FIG. 6.—Section of tumor mass found in the lung which shows characteristic cells of spongioblastoma multiforme. Hematoxylin-eosin x 60.

In their excellent article upon the spongioblastoma multiforme, Globus and Strauss record no instance of metastases and attribute this fact to the limited migratory tendency of the spongioblast due to its special morphology. Spongioblastomas invade the surrounding cerebral tissue diffusely and produce degenerative changes in the neighboring normal brain cells. It is this constant process of destruction and repair which, in the opinion of Cushing and Bailey, produces the multiformity of their structure.

In Cushing's large series of verified intracranial tumors the spongioblastomas represented about one-third of all the classified gliomas. Because of their tendency to recur, even after the most extensive attempts at surgical removal, they have no doubt been the cause of the discouraging impression prevalent with regard to gliomas as a group. The clinical course of the case here reported furnished a typical example of their outstanding characteristics. At the first operation it was thought that an apparently enucleable mass had been removed. The photograph of the autopsy section shows how extensive and wholly undemarcated from normal brain tissue the tumor was at that time. The rapid growth and extension in spite of intensive deep X-ray therapy adds another discouraging chapter to the story. At present, at least, it appears that surgical treatment of these tumors can serve only to prolong life, save vision and alleviate pain. It should not be forgotten that the

spongioblastomas of the brain do not stand alone in this respect among malignant tumors.

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THE RÔLE OF THE DURA MATER IN CRANIAL DECOMPRESSIVE OPERATIONS

A NOTE ON THE PRESERVATION OF THE INNER LAYER OF THE DURA IN CRANIAL DECOMPRESSIVE OPERATIONS, AND ON THE USE OF THE OUTER DURAL LAYER FOR THE PLASTIC CLOSURE OF DURAL DEFECTS

By Charles A. Elsberg, M.D.
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The cranial dura mater consists of an external or parietal and an internal or visceral layer. These are adherent to each other to form one membrane, excepting in the locations where the two layers are separated to enclose the venous sinuses, the pituitary body, and the Gasserian ganglion.

The outer or parietal layer of the dura is relatively thick, consists of fibrous with some elastic tissue, serves as the periosteum of the inner surface of the bones which form the cranial cavity, and in it or on its surface run the meningeal vessels. The inner or visceral layer is relatively thin, is composed mostly of elastic fibres, and is united to the outer layer by fine strands of connective tissue.

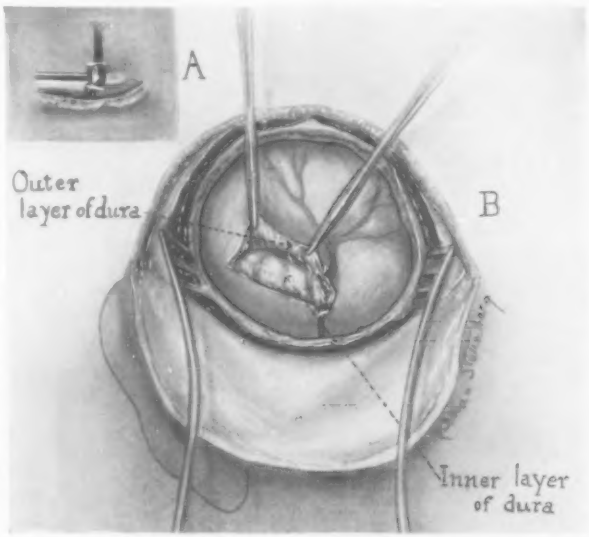

Fig. 1.—The first stages in the separation of the outer from the inner layer of the dura. *A*. Two clips supplied to the meningeal artery after the outer dural layer has been incised and the vessel with the outer layer raised up by means of a grooved director. *B*. The meningeal artery has been divided and the separation of outer from inner layer of dura has been begun.

If, at the operating table, the proper cleavage plane between the two lamellæ has been found, and the branches of the meningeal vessels which cross the field have been ligated, the external can be stripped or peeled off from the internal layer without special difficulty and without bleeding.

The blood supply of the inner is derived from the vessels in the outer layer, and after the latter has been separated from the former, incision of the inner layer is bloodless—unless a cortical tumor is adherent to the dura or unless as the result of trauma or an inflammatory disease there are vascular adhesions between the leptomeninges or cerebral cortex and the inner surface of the dura.

The inner layer of the dura is thin and yielding, and if there is an increase

of intracranial pressure, the brain covered only by this internal lamella will bulge through a defect made in the outer layer.

A recognition of the facts above enumerated has led us, in a number of instances, to preserve the inner layer of the dura in some of our decompressive operations, and to use the outer layer of that membrane for the plastic closure of dural defects.

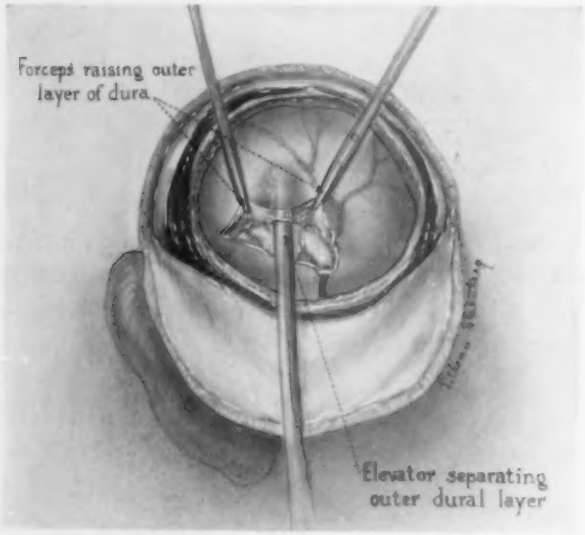

FIG. 2.—The blunt elevator separating the outer from the inner layer of the dura.

The improvements in the methods for the localization, the approach to, and the removal of intracranial tumors have reduced the number of cases in which a subtemporal decompression is necessary. The operation must still be done, however, at base of a bone flap where a neoplasm is irremovable, or as a temporizing procedure in unlocalized growths and in some patients with increased intracranial pressure after cranial trauma.

As originally proposed by Cushing, the typical decompressive operation for supratentorial expanding lesions is performed in the right temporal region where the resultant brain hernia is covered and supported by the temporal muscle, and the dura has always been incised or excised so that the brain can protrude through the defect made in the membrane.

FIG. 3.—Subtemporal decompression with preservation of the inner layer of the dura. The outer layer has been excised and the brain covered by the inner layer is beginning to herniate.

In states of increased intracranial pressure, a perfectly satisfactory decompression can be obtained if only the outer dural layer is excised, and unless there were special indications for subdural exploration or drainage, we have in a number of instances performed a subtemporal decompression

with preservation of the inner layer of the dura. By this modification of the usual technic, the injury to the cortex which may occur from the violent protrusion of the brain as soon as the dura has been incised, and the later formation of adhesions between the cortex and the overlying muscle is prevented. The herniation of brain covered by a thin layer of dura occurs more gradually, but at the expiration of a few weeks the bulging is no different from that which occurs when the entire dura is divided.

Technically, the following details require mention. After the bone defect has been made, the outer layer of the dura in the lowermost part of the exposed area is incised along the course of the middle meningeal artery or one of its branches. By means of a grooved director the outer layer of the dura with the vessel is raised up and the artery divided after silver clips or ligatures have been applied (Fig. 1). A smooth periosteal elevator or a blunt dissector is then passed under the outer layer which has been grasped and raised up with mosquito forceps and this layer gradually detached by slowly sweeping the instrument from side to side (Fig. 2). In order that the line of separation may be visible, the incision in the outer layer is progressively enlarged until the dissection has been carried out to the edges of the bone defect. The outer layer is then excised about one-half to one centimetre from the margins of the bone, any small bleeding vessels being ligated or caught with silver clips (Fig. 3). The suture of the muscle, fascia and subcutaneous tissues follows: If the subcuticular stitches are carefully inserted, a skin suture is unnecessary. The inner layer of the dura is usually so thin and transparent, that the cortex is visible through it. Some care must be taken in the separation of the two layers and occasionally a small rent has been made in the inner layer. This is of no especial significance. In some instances, the outer layer of the dura can be separated into two lamellæ so that the operator might be raising only part of the external layer of the dura in the belief that the entire layer was being elevated. The best guide is the dura in the region of the meningeal artery. If the proper cleavage plane has been found, a fairly thick layer of dura should be raised with the vessel.

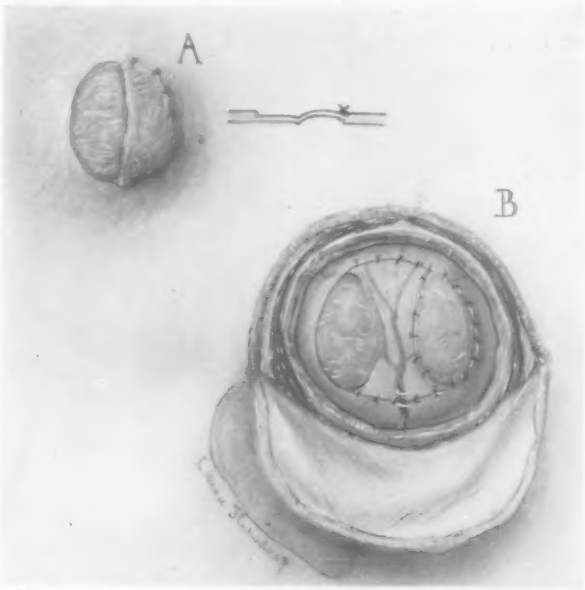

FIG. 4.—*A*. Plastic closure of a defect in the dura by means of a flap from the outer layer. *B*. Closure of a dural defect by a free transplant from the outer layer. (Somewhat diagrammatic.)

PLASTIC CLOSURE OF DEFECTS IN THE DURA BY MEANS OF FLAPS OR TRANSPLANTS OF THE OUTER LAYER

In a number of instances in which, due either to increased intracranial pressure or to the fact that an area of dura had been excised with a cortical growth, the cut edges of the dura could not be approximated, we have closed the defect by means of a flap of the outer layer of the dura which was raised and turned down so that its external surface lay against the cortex, and the edges of the flap were sutured to the free margins of the

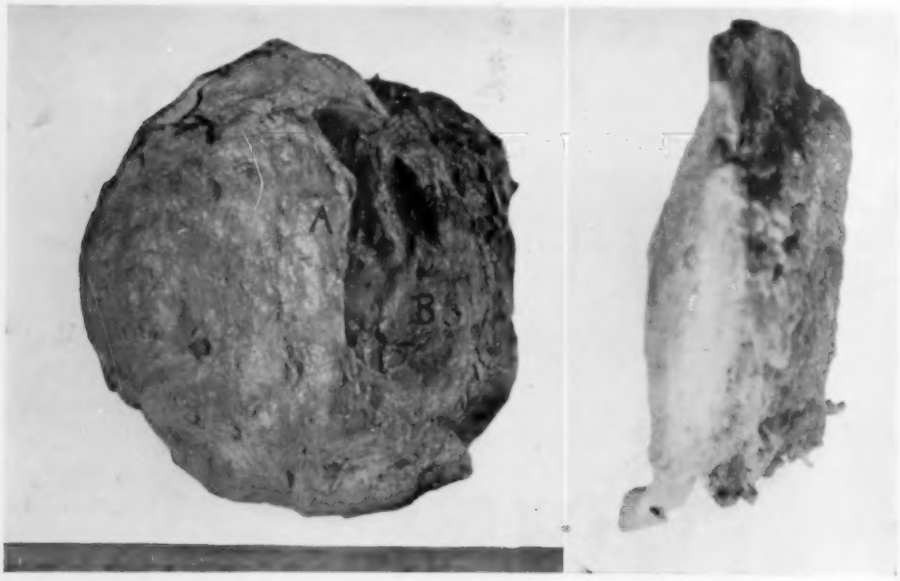

FIG. 5.—An extradural meningioma removed with only the outer layer of the dura. *A*. External layer of dura. *B*. Capsule of tumor.

dural incision. By this means, a defect three to four centimetres in size in both diameters can be closed by this little operation on the dura (Fig. 4A). After we had performed this plastic operation on the dura in a number of patients, I found, in the study of the literature, that Brüning (*Deutsche Zeitschrift für Chirurgie*, vol. cxiii, pp. 413–417) had proposed the same procedure in 1912, and had used it with satisfactory results in three cranial operations.

We have, in several patients excised a piece of the outer layer of the dura and transplanted it into a defect at some distance away (Fig. 4B).

Finally, it is feasible in some operations for meningeal tumor only slightly adherent to the dura, to excise only the inner layer of that membrane with the growth. Such a procedure will, however, be only rarely permissible on account of the danger that the outer layer of the dura may contain tumor cells. In one instance of extradural tumor—a flat meningioma (Fig. 5)—only the outer layer of the dura was removed with the neoplasm.

ACQUIRED ARTERIOVENOUS FISTULA*

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Arteriovenous fistula, strictly speaking, applies to a direct communication between an arterial and a venous channel. This would therefore be the aneurismal varix of former classifications. When there is an intervening false aneurismal sac between an artery and vein the term varicose aneurism has been applied. The less common varieties, venous encysted varicose aneurism, arterial encysted varicose aneurism, double arterial and venous encysted varicose aneurism, double arterial or venous intermediate encysted varicose aneurism, arteriobivenous aneurism, and so forth, are all interesting academically, but the essential and practical feature of them all is the communication between the arterial and venous channel.

To William Hunter (1757) properly belongs the credit of first describing accurately the clinical features and the local and regional vascular physiologic disturbances of arteriovenous fistula. He observed two cases in which the condition developed in the arm by venupuncture with accidental piercing of the artery in addition to the vein. Morvan (1847) attributed to Boisseau the first intimation that a cardiac affection may complicate arteriovenous aneurism. Branham (1890) first described the important sign which has been given his name. It is mainly to contemporaneous investigators (first among whom are Halsted, Matas, Makins, Holman, Hoover and Beams, Reid, Lewis and Drury), however, that we owe most of our knowledge of the systemic or cardiovascular effects of the condition. These observers, even with their modern methods and instruments of study, are not in accord. A brief discussion of the two main theories of the pathologic physiology of the systemic effects will be given here.

CALLANDER'S ANALYSIS OF THE CAUSES OF ARTERIOVENOUS FISTULA

189 projectiles	28 contusions
166 bullets	5 fractures
2 bombs	20 secondary aneurisms
5 shrapnels	7 doubtful origin
9 shell	3 congenital
6 pieces of metal	34 unknown
1 grenade	
161 knife wounds	447 total
38 venesections	
123 cuts and stabs	

Callander (1920), at Halsted's suggestion, analyzed 447 cases of arterio-

*Work done under the direction of Dr. J. de J. Pemberton and Dr. G. E. Brown, Divisions of Surgery and Medicine, Mayo Clinic.

venous fistula, including all cases recorded in the literature to 1914, all cases recorded in the surgical histories of Johns Hopkins Hospital, and a number of reports of selected cases appearing in the surgical literature of the World War. Callander's table, quoted on p. 19, shows the predominating cause of arteriovenous fistula to be some form of traumatism, and rarely congenital.

Saint, of the Mayo Foundation (1926), reported three cases of congenital arteriovenous fistula. In these cases the extremity affected had been abnormal since birth, either excessively hot or enlarged, and in all Pemberton found it necessary to amputate the distal part of the extremity because of extensive ulceration or gangrene which would not heal. Congenital arteriovenous fistula is a developmental anomaly in which there are always multiple fistulas between the arteries and veins as opposed to the single communication usually found in traumatic cases. This multiplicity of fistulas makes surgical treatment very unsatisfactory.

Four cases of acquired arteriovenous fistula, all of which were in the process of examination and treatment at the same time, are reported in this paper. One was due to a gunshot wound and three to contusions. The first case illustrates some of the cardiovascular effects. The other three were accompanied by local and regional changes only. Operation was performed in all the cases.

CASE I.—*Fistula Between the Axillary Artery and Vein.*—A man, aged twenty-one, a postal clerk, while attempting to make new alignments of the sights of an "unloaded" 0.22-calibre repeating rifle which had been placed in a vise at an upward angle of 45 degrees, was accidentally shot in the left side of the chest from a distance of about 3 feet. The bullet entered the third left intercostal space medial to the anterior axillary line. Later a röntgenogram showed it in the region of the left acromion process. External hemorrhage was severe, and a large swelling appeared beneath the left pectoral muscles; there was also subcutaneous emphysema between the puncture wound and the left clavicle. The left arm was completely paralyzed at first. Proper emergency treatment was instituted and the patient recovered from the immediate effects of the injury. About two months later (October, 1926) a pulsating swelling below the left clavicle was discovered by a physician and aneurism diagnosed.

On the patient's admission to the Mayo Clinic three months after the accident he complained of inability to use the left wrist and hand, of dull aching pain in the hand and sometimes in the shoulder, and of numbness and sometimes tingling in the back of the hand, inner side of the forearm and in the fourth and fifth fingers. The entire left upper extremity above the wrist was larger than the right, with flattening of the deltoid region. There were no enlarged veins. The back of the hand was markedly œdematous and the hand and fingers were of a reddish cyanotic hue and felt cold. There was limitation of shoulder and elbow movements by about 40 per cent., some limitation of pronation and supination, wrist-drop with inability to flex or extend the fingers and anæsthesia in the distribution of the cutaneous branches of the radial and ulnar nerves: in short, evidence of injury of the medial and posterior cords of the brachial plexus. Just below the outer half of the left clavicle was a pulsating fulness over which was a continuous thrill within a circle with a radius of about 4 cm. A loud hum with systolic accentuation was heard over the upper anterior and posterior portions of the wall of the chest, loudest over the area of the thrill and conducted down the inner side of the left arm as far as the elbow. The pulses were equal and synchronous and of the

water-hammer type. Systolic blood-pressure in the right arm was 130; the diastolic seemed to be about 60, although the sounds were heard down to zero. On account of the bruit, it was necessary to use the palpatory method on the left arm, and the systolic pressure was found to be between 50 and 60. In the femoral vessels the pressure was about 170 systolic and 100 diastolic. The average pulse rate was 85. Digital compression of the subclavian artery behind the upper border of the inner half of the clavicle eliminated the pulsation, thrill and bruit, as did pressure over the point of maximal intensity of the thrill. The pulse rate during this manœuvre immediately dropped 12 beats a minute, from 87 to 75 (Branham's bradycardiac sign). The systolic blood-pressure taken in the right arm did not change appreciably, but the diastolic became definite at about 78. Subcutaneous injection of 1/30 of a grain of atropine sulphate caused the pulse rate to increase in twenty-five minutes to 124. Occlusion of the left subclavian then caused a drop of only 9 beats a minute. In either case immediately after release of compression the pulse rate resumed its original and more rapid rate. Capillary pulsation was not noted. The blood now in the left arm was not great enough to be measured with the Stewart apparatus available. The skin temperature of the two upper extremities was practically the same, although after the patient entered the hospital from the cold outside air the left hand was distinctly colder than the right. The heart was 12.5 cm. in transverse diameter and there were no murmurs. The electrocardiogram did not show significant changes. Blood drawn from veins in the antecubital region had an oxygen saturation of 67 per cent. on the right and 81 per cent. on the left, indicating that the blood in the veins of the left arm was half arterial and half venous.† The blood volume as determined by the Congo-red method and with specimens from both arms gave an average reading of 89 c.c. for each kilogram of body weight. The hematocrit ratio and the blood counts were within normal limits. The Wassermann reaction on the blood was negative. A diagnosis was made of a small arteriovenous fistula of the third portion of the left subclavian artery and vein or of the first portion of the axillary and injury of the brachial plexus.

December 15, Pemberton operated through an anterior incision and found that the communication was between the axillary vessels under the pectoralis minor, which he divided (Fig. 1). The cephalic vein was greatly dilated and the axillary artery proximal to the fistula was slightly enlarged. The axillary vein was in a mass of scar tissue and owing to the fact that a nerve, evidently the medial cord of the brachial plexus, entered this same mass, he did not try to dissect the vein free below. He ligated the artery above and below the fistula and the vein above with heavy silk.

Recovery was uneventful. Surgical repair of the brachial plexus was deferred. After operation the left hand was warm and more nearly normal in color. On the tenth day the blood-pressure in the right arm was about 120 systolic and 68 diastolic and the sound was no longer heard below the normal fourth phase. The femoral pressure was about 160 systolic and 100 diastolic. A small pulse was perceptible in the region of the left radial artery. The pulse in the right radial did not seem to be of the water-hammer type. The average pulse rate was 80 a minute. The cardiac shadow on the seventeenth day after operation was 12 cm. in transverse diameter. The blood volume had not changed.

The patient returned June 10, 1927, for repair of the left brachial plexus. Pain in the left arm had ceased. There was some improvement neurologically, although the function of the nerve trunks was still impaired, the ulnar nerve being most involved. The hand had the appearance of median nerve change. There was greater amplitude of rotation at the shoulder-joint. The œdema of the hand was somewhat reduced. The fistula recurred. There was a slight thrill and pulsation over the site of the fistula and a marked hum over the upper left side of the chest and down the inner side of the left

† This test was suggested by Dr. George E. Brown.

arm to the elbow. The blood-pressure in the right arm was 136 systolic and 76 diastolic, and in the left by the palpatory method the systolic pressure was about 50. The pulse rate was 88. There were no other changes in the cardiovascular system. June 15, Adson exposed the fistula and the left brachial plexus. Bleeding was profuse. The subclavian artery above and the axillary artery below were pulsating into a mass at the site of the fistula, and the subclavian, brachial and cephalic veins were also pulsating into this mass. In an attempt to dissect the brachial plexus the aneurism was opened from below. The brachial plexus was then traced down from above and the aneurism

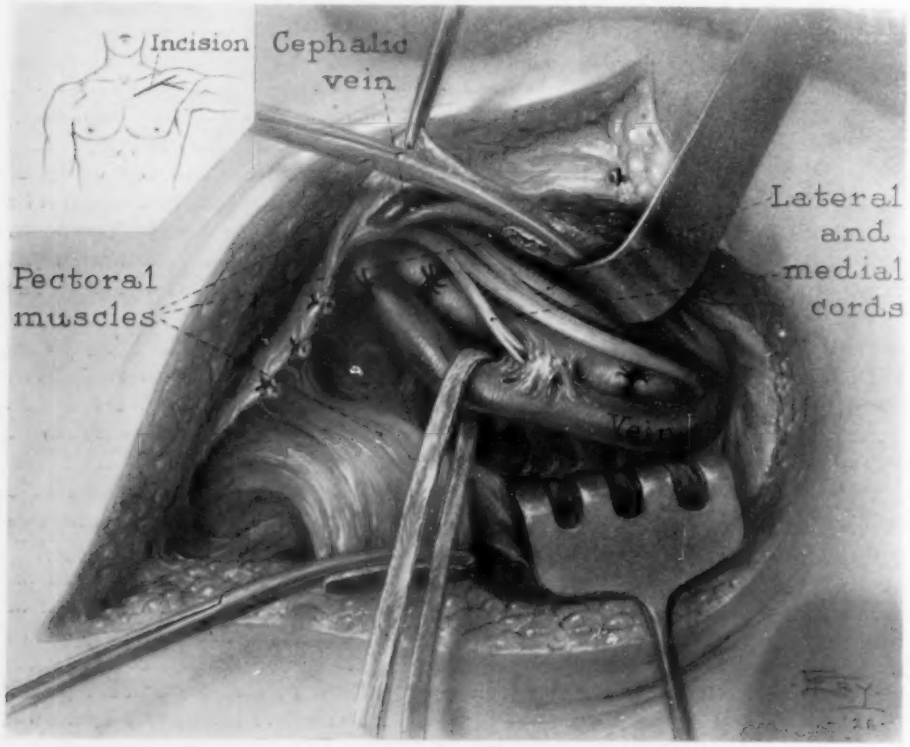

FIG. 1.—(Case I.) Axillary artery and vein, site of fistula, and the relationship of the brachial plexus to the fistula, as noted at the first operation. The vein distal to the fistula was embedded in a mass of scar tissue and could not be isolated without further injury to the nerves. The points of ligation are indicated. Insert shows the incision of approach.

opened again. It was necessary then to ligate the subclavian artery and vein, the upper end of the brachial artery just above the profunda, and the cephalic and brachial veins and to resect the whole aneurismal mass. The dissection of the brachial plexus was continued, and the inner head of the median nerve, the ulnar nerve and the radial nerve were found to have been severed. An end-to-end anastomosis of these nerves was made after resection of the neuroma. The following day the collateral arteries and veins leading into the old aneurism were ligated. Convalescence was stormy and complicated by infection of the wound. Up to the time of dismissal from observation, July 13, no definite improvement in the neurologic condition was noted.

Comment.—This patient manifested the bradycardiac reaction, the increased heart rate, the increased pulse pressure, the arm-leg differential pressure, and questionable enlargement of the heart. Although the fistula was small, it might in time have caused serious cardiac embarrassment. This case

brings up the question of the necessity of testing the efficiency of the collateral circulation. Matas [9] advises testing of the collateral circulation before the ligation of the main source of blood supply to a limb, and if this does not seem sufficient, to "train the collaterals" by periods of compression of the vessels to be ligated. Reid has demonstrated that this procedure is not necessary and has called attention to the fact that the fistula is itself a greater stimulus to the formation of collaterals than is the tying off of the main artery. If the vessels cannot be restored, however, by some form of endoaneurismorrhaphy,[10] the best procedure is to ligate both artery and vein above and below, since single or double ligation of the artery alone may lead to gangrene of the limb due to the rapid drainage of the blood supply from the collateral arteries through the large vein as well as through the collateral veins. The balance between inflow and outflow is maintained by ligating both artery and vein. Recurrence in this case was probably due to inability to ligate the vein below the fistula, and it was necessary at the second operation to excise the fistula in its entirety.

FIG. 2.—(Case II.) Patient just prior to operation with well marked exophthalmos and paralysis of the external ocular muscle of the left eye.

CASE II.—*Pulsating Exophthalmos Believed to be a Fistula Between the Internal Carotid Artery and the Cavernous Sinus.*—A man, aged forty-eight, was in an automobile accident October 21, 1926, and was picked up unconscious. He regained full consciousness in seven hours. The scalp was lacerated in the right parietal region but there were no other injuries. Simple concussion of the brain was diagnosed. Since the accident he had experienced a "swishing" noise in the left ear synchronous with the heart beat and on the third day diplopia appeared with intermittent frontal headache which was worse after he had assumed the reclining position. Both eyes were bloodshot and the eyelids swollen; they became normal in two weeks, but soon afterward the left conjunctiva became congested and the eyeball began to protrude.

On examination at the Mayo Clinic, December 6, there was moderate proptosis of the left eye with moderate œdema of the lids and marked conjunctival congestion and chemosis, lacrimation and epiphora. The exophthalmometer registered 25 mm. on the left and 18 mm. on the right. The left pupil was slightly larger than the right, but both reacted normally to light. There was complete paralysis of the left external rectus and some limitation of movement of the orbit in all directions. Vision was normal. Slight pressure on the eyeball elicited a faint pulsation synchronous with the heart beat. The veins of the left retina examined with the ophthalmoscope were considerably engorged. A continuous loud hum with systolic accentuation was heard over the entire cranium

and both eyeballs, but was most intense over the left eyeball. Occlusion of the left carotid by pressure caused the pulsation, hum, and subjective swishing to disappear, but did not definitely alter the pulse rate. The average pulse rate was 72. The systolic blood-pressure was 116 and the diastolic 76. The heart was not enlarged. A röntgenogram of the skull was negative. A diagnosis was made of arteriovenous fistula between the left internal carotid and the cavernous sinus with pulsating exophthalmos (Fig. 2).

December 16, Pemberton ligated the left internal carotid artery in the neck. The pulsation, hum, and swishing disappeared, but a soft continuous humming sound continued in the right ear. On the fifteenth day after operation the proptosis was much reduced, the exophthalmometer reading 21 mm., the conjunctival congestion and chemosis had disappeared, and the retinal veins were nearly normal in size. The ocular palsies were about the same as before (Fig. 3). Five months after operation the patient reported that he had had no headaches and no subjective sound in the ear. He still had some strabismus and suffered occasional momentary attacks of double vision.

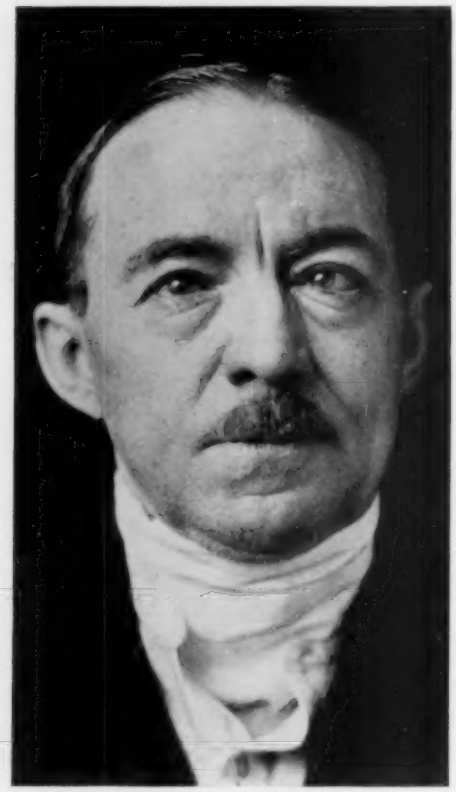

FIG. 3.—(Case II.) Two weeks after operation, exophthalmos greatly reduced and the ocular palsy remaining.

Comment.—In an extensive review of the literature from 1809 to June, 1923, Locke found 588 cases of pulsating exophthalmos. The etiology was noted in 544 cases. Twenty-three per cent. were spontaneous and 77 per cent. were traumatic. In the spontaneous cases females predominated (74 per cent.). The average age in cases of the spontaneous type was near the end of the fifth decade, and in the traumatic cases near the end of the third decade. Necropsy was performed in fifty cases, thirty-three in spontaneous cases and seventeen in traumatic. Of the thirty-three spontaneous cases no lesion was found in four; probable communication between the carotid artery and the cavernous sinus was found in sixteen; orbital tumor was found in seven, and aneurism of the ophthalmic artery in three. In sixteen of the seventeen cases of traumatic pulsating exophthalmos there was a communication between the carotid artery and the cavernous sinus, and in one there was an aneurism of the carotid. There is a close anatomic relation of the sphenoid bone, cavernous sinus, internal carotid artery, the second, third, fourth and sixth nerves, and the ophthalmic and maxillary divisions of the fifth nerve. In explaining the relative frequency of this lesion after severe head injuries Locke quotes Rawlings as stating that the sphenoid bone was

involved in 70 per cent. of all fractures of the base of the skull. Locke, reviewing the result of treatment, found the following:

	Cases	Cured or improved, per cent.	Mortality per cent.
Compression of carotid	106	26	..
Ligation of common carotid	234	65	9
Ligation of internal carotid	38	88	8
Bilateral ligation of carotid	21	62	14
Ligation of orbital veins	19	68	5
Ligation of orbital veins and ligation of carotid	24	71	17
Rest and medication	28	50	4
Gelatin injections (subcutaneous)	16	63	..

It is difficult to explain why ligation of the internal carotid cures in so many cases. It may be that the slowing of the blood stream through the fistula incident to the ligation of the carotid artery is more marked than normal because of the obstruction to blood flow offered by the trabeculations in the cavernous sinus, permitting clotting in the fistulous tract to take place before the secondary rise of blood-pressure in the carotid after the complete reëstablishment of the collateral circulation. It is not necessary to institute a course of digital compression preliminary to ligation of the carotid artery in cases of true arteriovenous communication, as has been advised, since the fistula itself serves as a stimulus to collateral circulation. The fistula rarely produces systemic disturbances but may seriously affect the eye.

Case III.—*Fistula Between the Temporal Artery and a Vein of the Scalp.*—A Russian-Canadian farmer, aged thirty-eight, came to the Mayo Clinic complaining of a chronic cough. Nine years previous to admission a limb of a tree about 5 cm. in diameter and several feet long struck him on the top of the head as the tree fell. A tender, firm, blackish lump formed in the left parietal region, but he continued to work. The lids of the left eye were swollen and black. The lump gradually disappeared, leaving a soft swelling in the left parietal region. Enlarged veins down the front of the forehead had appeared only within the last three years. He felt a throbbing at times in the head, and if he wore a tight cap he heard a humming sound in both ears.

December, 1926, examination of the shaved scalp showed several large and tortuous veins diverging from a large, pouchy, fluctuating swelling, 3 by 4 by 1 cm., in the left parietal region (Fig. 4). The left temporal artery was enlarged, thick, and tortuous and entered this main swelling, in which it could be palpated. The left occipital artery was also enlarged and travelled upward toward the swelling. The parietal branch of the right temporal artery could be palpated as it passed over the vertex to the region of the swelling. Over the point of greatest swelling could be felt a marked thrill, and a loud continuous bruit with systolic accentuation was heard on auscultation over the swelling. The latter was transmitted down the left temporal artery as far as the zygoma, part way down the left occipital artery, and was present to a lesser degree over the vertex of the skull. Pressure at the point of maximal thrill caused a cessation of the bruit and thrill and collapse of the veins. When the left temporal artery was occluded the thrill and bruit were greatly reduced, and the pulsation in the temporal artery in the swelling was decreased. If both temporal arteries were occluded there was still greater diminution in these signs; if the left occipital was also compressed the effect was practically the abolishment of the signs, and if the right occipital artery was also shut off the signs disappeared entirely. Blood drawn from the venous swelling

near the thrill had an oxygen content of 94 per cent. It was, therefore, arterial blood. In the course of the main swelling there was a depression in the skull which resembled a groove. A röntgenogram of the skull, however, was negative. Examination of the general cardiovascular system revealed nothing of significance. A diagnosis was

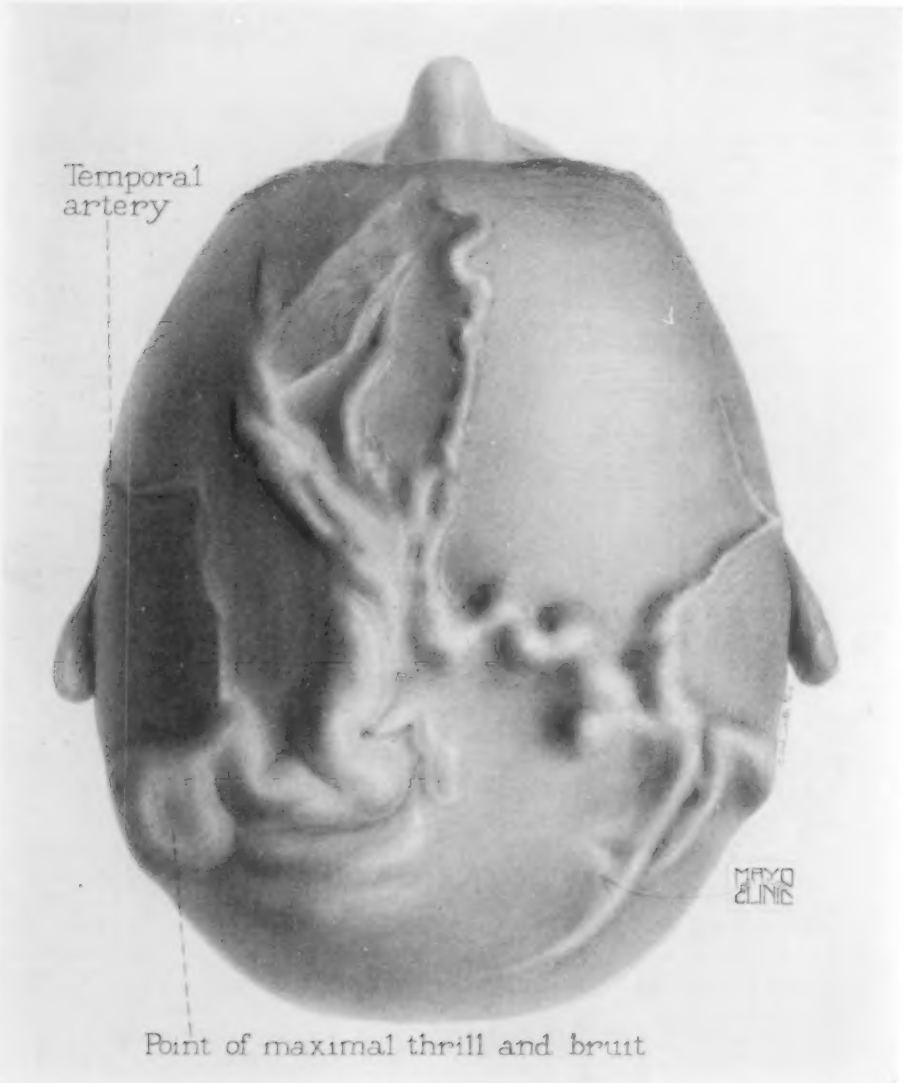

FIG. 4.—(Case III.) Shaved scalp viewed from above and showing the cirsoid aneurism. Site of anastomosis is indicated.

made of arteriovenous fistula between the parietal branch of the left temporal artery and one of the veins of the scalp; the right temporal artery and both occipitals anastomosed with branches of this artery and in this way helped to feed the fistula. There had been no effect on the general circulatory system after nine years, and it was therefore decided to extirpate the fistula for local reasons only.

December 31, Pemberton ligated both superficial temporal arteries and the right occipital artery, placed a circle of hemostatic sutures in the scalp around the fistula,

made a curved scalp flap and excised a large segment of the vessels. The skin over the vessels was very thin, due apparently to fat atrophy; this had given the sensation of a depression in the scalp on palpation. Dissection of the removed vessels revealed a small fistula with thickened walls between the artery and vein. The vein was greatly dilated, and the artery generally hypertrophied. Convalescence was uneventful.

CASE IV.—*Fistula Between the Artery and Vein of the Superficial Palmar Arch.*—A man, aged thirty-two, had injured his right hand thirteen years before while playing baseball. A firm swelling appeared suddenly in the palm after an impact with the ball. The swelling gradually declined, leaving a soft, fluctuating, bluish lump at the base of the middle finger, extending part way up the sides of the finger. Five years later he noticed a scaly, tender area below the tip of the middle finger. This spread a little during the next year. He then consulted a physician who made a röntgenogram and told the patient that the bones of the finger were dead from lack of nourishment. The finger was amputated at the metacarpophalangeal joint; the flaps healed quickly. A year before examination he noticed a scaly area on the dorsal region of the stump similar to the one which had been on the tip of the finger. At one time a little fluid collected and ruptured through the skin, but healing occurred after a few days of drainage. The swelling at the base of the amputated finger had not increased in size in the thirteen years of its existence.

FIG. 5.—(Case IV.) Palmar aspect of the right hand, showing the swelling just proximal to the stump of the amputated finger and the enlarged veins above the wrist.

On examination in December, 1926, it was observed that the veins of the right forearm and back of the hand were more prominent and more numerous than normal. At the distal end of the third metacarpal bone over the site of amputation and mainly on the palmar surface was a fluctuating bluish mass about 2.5 cm. in diameter, which was felt to pulsate faintly synchronous with the pulse (Fig. 5). The palm of the right hand was moist and warm; the backs of the fingers were bluish and the palm was somewhat pallid. On the dorsal surface of the swelling was a purplish scaly area. If the hand was tightly clenched and then opened there was delay of the return of color in the palm. No thrill could be palpated. A moderately loud hum with systolic accentuation was audible on auscultation in the proximal half of the palm and over the back of the hand, especially between the metacarpal bones, and was conducted up the course of the radial artery half way to the region of the elbow and a short way up the course of the ulnar artery. It was loudest over the hypothenar eminence. Occlusion of the radial artery had little effect on the sound; occlusion of the ulnar stopped it. Blood drawn from a large vein of the right forearm showed an oxygen content of 94 per cent. indicating the blood of the vein to be arterial. A röntgenogram of the right hand showed slight periarticular arthritis of the phalangeal joints. Examination of the general cardiovascular system revealed nothing abnormal. Arteriovenous aneurism of the superficial palmar arch, possibly with multiple anastomoses, was diagnosed. Surgical interference was indicated for local reasons only.

December 31, Pemberton, hoping that the communication might be a simple one involving only the digital vessels to the amputated finger, exposed the fluctuating swelling through a curved lower palmar incision. The fistula was apparently more proximal, and since in order to extirpate it the circulation of the whole hand would have been jeopardized, only the third and fourth digital branches of the superficial palmar arch and the veins at the stump of the middle finger were ligated. Healing was prolonged, and the same signs were present after operation as before.

Comment.—There was some question in this case as to whether there was actually an arteriovenous anastomosis, but this was definitely settled by the determination of the oxygen content and capacity of the blood in the veins from the forearm. This method of diagnosis is simple and positive. The blood is drawn from a vein in the region of the lesion if possible; if it shows an oxygen content well above normal (70 per cent.), it is mixed with arterial blood, a condition which is possible only with an arteriovenous anastomosis.

DISCUSSION

The local effects of a fistula consist in dilatation of the distal part of the vein and of the proximal part of the artery. The increased pressure in the vein causes it to expand and hypertrophy and only later brings about incontinence of the valves of the vein; the tributary veins also become dilated. The pressure in the veins is increased and the veins may pulsate. The artery proximal to a large fistula becomes dilated and thin-walled and often shows marked degenerative changes. The surface temperature over the fistula is usually increased, that distal to it decreased. The limb distal to the fistula is often increased in girth due to œdematous infiltration and hypertrophy of the subcutaneous connective tissue with atrophy of the skin and skeletal muscles, and if the anastomosis occurs before the full growth of bone has been attained, there may be an increase in the length of the limb. Trophic changes are prone to occur distal to the fistula. These are due to diminution of the flow of blood through the capillaries owing to its easier path of escape into the veins through the fistula and to the increased pressure in the veins, impeding the return of deoxygenated blood from the capillaries. Anoxemia of the tissues results. If these tissues are even slightly injured the normal inflammatory reaction of repair is feeble or absent, and progressive ulceration or gangrene supervenes. A loud hum with systolic accentuation is heard on auscultation over the fistula and in its neighborhood, and is transmitted down the course of the vein. A thrill is palpable also over the fistula and may be transmitted a short distance along the vein. There is an abnormally high oxygen content of the blood taken from veins near the site of the fistula due to a large admixture of arterial blood. Simple arterial aneurisms rarely cause as marked local or regional disturbance. The murmur is not constant, but when present is systolic in time and therefore intermittent. The thrill if present is less marked. The venous phenomena do not occur and the blood has the normal content of venous blood.

The relatively large number of cases arising from the World War has stimulated several able surgeons and internists to investigate the systemic effects of arteriovenous fistula. The fact that the World War was more productive of this type of vascular lesion was due to the use of small calibre bullets and shrapnel of high velocity which produced a small orifice and exit for the bullet, a narrow but long curved channel usually crossing the course of the vessels in an oblique direction, and a small perforation in the artery, followed by rapid closure of the wound and primary union of the bullet's track. Matas [11] states that the conditions in the fistula that determine or influence the systemic effects are: (1) the size of the fistula; (2) the volume and force of the arterial stream, short circuited; (3) the calibre of the vessels involved; (4) the proximity of these to the heart; (5) the duration of the fistula; (6) the age of the patient, and (7) the coexistence of antecedent cardiovascular disease. Of these factors the first four are the most important. Fistulas of the iliac, femoral, popliteal, subclavian, axillary, brachial, innominate, and carotid vessels are, of the accessible surgical vessels, most likely to be followed by cardiovascular effects. The systemic changes of the large fistulas are: (1) enlargement of the heart; (2) accelerated heart rate; (3) high pulse pressure, usually due to low diastolic pressure; (4) changes in the pulse and blood-pressure from temporary occlusion of the fistula, especially Branham's bradycardiac sign; (5) the presence of cardiac murmurs, more often systolic at the apex; (6) capillary pulse; (7) high blood-pressure in the leg compared to that in the arm, and (8) increased respiratory rate with dyspnœa on exertion, diminished vital capacity and diminished voluntary control of respiration (holding the breath test).

Branham's bradycardiac sign is said to be pathognomonic of arteriovenous fistula. It consists in immediate and distinct slowing of the heart rate when the fistula is temporarily occluded, either by pressure directly over the leak or by compression of the artery proximal to it. With it both systolic and diastolic pressures are usually raised, the diastolic often more than the systolic, and the cardiac shadow contracts. Besides its diagnostic importance it indicates cardiac efficiency and the ability of the circulation to "tone-up" after extirpation of the fistula. Atropine often abolishes the reaction, showing that it is a vagal effect.

The systemic effects may exist for months or years with adjustment or compensation of the cardiovascular system, but when a break occurs the evidence of cardiac insufficiency and decompensation appear. Even, however, if the liver is enlarged and pulsating, with a systolic centrifugal pulse in the veins, but without signs of pulmonary œdema and cyanosis, extirpation of the fistula may restore the circulation nearly to normal, provided that prior to operation there has been no evidence of ectasis of the right auricle, as shown by absence of flattening of the right subcardial diaphragm, and that the temporary occlusion of the fistula causes elevation of systolic and diastolic blood-pressure.[6]

American investigators [4,6] have concluded from clinical and experimental studies that when a large volume of blood is shunted from the normal system of heart, arteries, capillaries, and veins, into a new system of heart, artery, fistula, and vein there is a great decrease in peripheral resistance, the effect being similar to sudden dilatation of the whole peripheral bed in a normal circulatory system. Compensatory reactions must therefore occur to maintain the circulation through this enlarged peripheral bed and to ensure sufficient oxygenation of the tissues generally in spite of the amount of circulatory blood lost through the fistula. The minute volume flow of blood through the heart must be increased sufficiently to do this. It is brought about by an actual increase in blood volume, by dilatation of the heart to accommodate it, by hypertrophy of the heart to use it, and by increase in heart rate to insure the maximal utilization of it. In animal experiments carried out by Harrison, Dock and Holman [3] it was shown that there is a great increase in minute volume flow of blood through the heart, as indicated by measurement of volume flow through the lungs. Other animal experiments of Holman's [5] also showed marked increase in total blood volume in cases of large fistulas. In a few clinical cases at the Mayo Clinic a post-operative reduction of total blood volume was noted, as determined by the Congo-red method, suggesting that there had been an increased volume, although the pre-operative figures were all within normal limits.

English investigators,[7] however, contend that the heart does not do more work because they believe they have proved that blood flowing through the capillary bed is seriously diminished and general venous pressure is not increased; the heart cannot put forth more blood unless more blood is brought to it, and this is not possible unless general venous pressure is increased. The pressure in the great veins cannot be increased without increasing the pressure throughout the whole venous system, and they have found that the pressure in the peripheral veins is normal. They account for the enlargement of the heart by dilatation due to defective nutrition of the myocardium, coronary blood flow being reduced because of the low diastolic pressure in the aorta. Because of this argument Matas [11] has raised the question: If this is true, why is it that so many persons tolerate their arteriovenous fistulas with comparative comfort in spite of this coronary insufficiency?

After a comparison of the data submitted by the two groups of investigators, the conclusions reached by the first group mentioned appear at present to be the more plausible and convincing, although the work of the other group cannot be lightly disregarded.

SUMMARY

Four cases of acquired arteriovenous fistula are reported. It was found in three cases that a determination of the oxygen content of blood taken from a vein in the region of the fistula revealed the presence of arterial blood in

the venous channel, as would be expected. This test is suggested as a pathognomonic criterion in all cases in which there is doubt as to the presence of an arteriovenous anastomosis.

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CORONARY DISEASE IN SURGICAL PATIENTS

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At no time in life is an adequate coronary circulation more needed and an inadequate one more hazardous than during a major surgical operation. The degree of integrity of the coronary vessels at this time is a subject of grave concern and because of its gravity an accurate appraisal of the pre-operative condition of the vessels unquestionably deserves earnest consideration.

The Nature of Heart Failure.—In the appraisal of the surgical risk a clear conception and early recognition of heart failure are essential. Sir James Mackenzie defines heart failure as " . . . that condition in which the heart is unable to maintain an efficient circulation during efforts necessary for the daily life of the individual," and continues, " . . . the main elements composing the circulatory system are the blood, the heart, the blood-vessels, and the nerves supplying and controlling the heart and blood-vessels. The different parts of the circulatory system are so constructed as to facilitate the flow of blood and so aid the work of the heart. The heart muscle supplies the force that propels the blood. So far then, as the efficiency of the circulation depends on the flow of blood the muscular force of the heart is the only factor concerned, and the inability of the muscle to supply a sufficient force is the direct cause of heart failure . . ." " The evidence of heart failure in the early stages is entirely subjective. The patient becomes conscious of certain sensations of distress or discomfort on making an effort which formerly he was able to make without experiencing these sensations.

" As the heart failure advances, these sensations are provoked by less effort. To fully appreciate the nature of heart failure it is necessary to remember that the important factor in maintaining the circulation is the heart muscle. There is a limit to the amount of work that a healthy heart can perform. It is the forcing of the heart to work beyond this limit that produces heart failure. Actual impairment is indicated when symptoms are produced with abnormal facility, as for example, an effort that the individual was want to perform in the past without any signs of distress. It is the abnormal facility with which the symptoms of exhaustion are produced and not the signs themselves that is the earliest sign of heart failure."

" The standard of estimating the heart's strength is found by ascertaining the response of the heart to effort. The standard by which the heart's strength is to be measured is not a fixed standard. It will vary with each individual examined. The field of normal response to effort varies widely in different healthy individuals. Every man knows the amount of effort he

can normally put forth without distress, and this amount of effort is the only practical standard by comparison with which it can be determined, whether the field of the heart's response to effort is restricted. The subjective symptoms of heart failure are never absent when the heart's efficiency is in any way affected. Methods of estimating the cardiac efficiency which do not take into consideration the sensations produced by effort fail to bring out the information essential to a knowledge of the heart's efficiency." [1]

Symptoms of Coronary Disease.—Coronary disease reveals itself by definite subjective manifestations. The sensory disturbances following physical exertion more especially, but also mental exertion, range from a mere discomfort regarded as insignificant by the patient to an excruciating agony that forebodes immediate dissolution. The pain which is preëminently the most important symptom is confined to fairly wide but well-defined regions, notably the precardium, retrosternum and epigastrium with or without radiation. The extension of the pain is almost exclusively to the left side—to the arm, shoulder, axilla, wrist, little finger, jaw, gums, tongue, neck, scapula, base of head—but occasionally also to the right. The pain may have its origin in any of the regions of radiation, notably the arm or wrist, and may or may not radiate to the precardium. It is always at some time or other felt in the precardium or retrosternum and its definite relation to physical exertion, immediate or remote, is a characteristic phenomenon. There is another sensory disturbance that may be associated with the pain or may arise independently of it—an expression of myocardial exhaustion that is felt as a constriction of the chest wall, the intensity of constriction varying from a mere tightness to a vise-like grip following exertion. Sudden exposure to cold, prolonged sleeplessness, worry, altercation, are likely to precipitate attacks. Salivation and local or general sweating may occur during a seizure, and profuse urination during or afterward is not unusual.[2]

Greenberg states "a peculiar sensation of a combination of nausea and discomfort in the epigastric area or a fluttering sensation in the substernal region, especially when associated with inability to perform accustomed tasks and coming on after a heavy meal, or periods of prolonged activity is another sign that the coronaries are no longer adequate . . . that the triad of pain, pallor and immobility, even when relatively slight, are sufficient to make a diagnosis and that in the face of normal graphic findings." [3]

The Central Nervous System.—The degree of hypersensitiveness of the central nervous system plays an important rôle in determining the significance of subjective symptoms. This aspect of the disease applies especially to women. An extremely hypersensitive woman with mild coronary disease may exhibit symptoms out of all proportion to the actual impairment to the coronary vessels. A careful appraisal of the degree of hypersensitiveness is essential in determining with any degree of accuracy the gravity of the condition. Pressure on the skull behind the ear is a useful method, for this region is relatively insensible to pain in the normal individual. Undue sensitiveness to deep pressure here is indicative of a hypersensitiveness by which

one may discount to a proportionate degree the gravity of the subjective symptoms. Inconstancy of the symptoms, and periods of freedom from distress on exertion, indicate that there is still present a fair degree of cardiac reserve. It is always necessary to measure the heart's efficiency under the most favorable circumstances in order to estimate the heart's ability successfully to withstand strain. As in normal individuals, so in patients with coronary disease, there is a wide variation from time to time in their response to effort.[4]

Objective Signs.—Unfortunately physical examination of patients with coronary disease reveals, as a rule, little that will aid in the appraisal of the surgical risk. There are, however, three signs that are peculiarly significant. The first—and it is of vital importance—is reduplication of the first apical sound, indicative of ventricular hypertrophy on the verge of failure.[5] All patients with this reduplication, irrespective of subjective symptoms, that have come to the writer's notice and have undergone a major operation, have died of progressive circulatory failure one to three weeks after operation. Muffled heart sounds at the apex in the absence of emphysema are of value when considered in conjunction with symptoms of distress in response to effort. Extra systoles that are increased by exercise indicate myocardial degeneration and their behavior must be considered in the circulatory appraisal of such patients.

Arterial Degeneration.—It is well known that degenerative processes, expressions of old age, take place throughout the body in varying degrees of intensity, and that the location of maximum intensity varies widely in different individuals. The kidneys, brain, heart, muscles, etc., each and all may be the seat of these processes and that organ system in which the process is most marked dominates the picture.

There is a special significance to these facts with reference to the appraisal of surgical patients. Marked degenerative processes in the muscles of the legs may serve to mask well-advanced myocardial degeneration. Subjective symptoms in response to effort are referable to the legs rather than to the heart. Appraisal of the cardiovascular system of this type of patient must depend on physical signs; and the presence of abnormalities in the electrocardiogram which indicates myocardial degeneration offers welcome aid; the absence of such abnormalities is, however, of questionable assistance.

Sex.—The importance of sex in the appraisal of the circulatory system cannot be overestimated. In man subjective symptoms and objective signs referable to the circulatory system indicate an impairment of that system of a more serious nature than do the same symptoms and signs in women. The circulatory system of the female will withstand more strain than is indicated by the symptoms and signs, whereas the same system of a male will withstand less than is indicated. That the symptoms and signs are less significant in women is well portrayed by one of the author's cases, a woman, aged fifty-eight; with marked limitation to effort by retrosternal pain, and at times constriction of chest. Marked hyperæsthesia over pre-

cardium. Vessels (radial) thickened. Heart enlarged (moderately). Sounds muffled. Blood-pressure 160–100. Operation radical, amputation of breast. Convalescence was smooth and uneventful.

Cardiodynamics.—A healthy heart responds to the demands of increased work by a stronger ventricular contraction. The physiological mechanism responsible for this augmented effort lies in an increased initial tension developed during diastole as a result of increased venous return. In other words, as venous return increases the healthy heart is capable of pumping out a larger volume of blood per unit of time. On the other hand, when alterations in inherent contractility are present, the musculature of the heart cannot respond so effectively to an increased diastolic volume and initial tension during periods of strain (hyperdynamic heart of Wiggers).[6]

When a patient with coronary disease is subjected to a major surgical operation we have superimposed on a hyperdynamic condition of the heart the additional handicap of reduced venous return produced as the result of surgical shock. It is evident in these circumstances that any material reduction in the venous return to the heart will result in progressive circulatory failure. The normal vascular system, to function properly, must contain at all times an adequate supply of fluids, but with alterations in inherent contractility inadequate venous return will eventually produce a physiological impasse.

Cholecystectomy and Coronary Disease.—In the appraisal of the coronary surgical risk the nature of the operation is an important factor bearing on the prognosis. An approximate estimate of the shock entailed by the surgical procedure must receive careful consideration. It is the author's belief that a cholecystectomy performed upon a male with even moderate coronary disease will in all likelihood prove fatal without adequate support of the circulatory system. Women, except in rare instances, are in a different category with respect to the necessity of this special support, for the hazard is materially reduced by virtue of the sex. The maintenance of adequate venous return, diastolic volume and initial tension, sine qua non in conditions of altered inherent contractility of the heart, is most effectively accomplished by transfusion of whole blood immediately before the operation. Transfusion after the operation may also be necessary; an immediate transfusion is advised if the patient's condition is unsatisfactory.[7] Maintenance, rather than reëstablishment, of a sufficient circulation is urgently demanded in these circumstances. The employment of this method, it is believed, would greatly reduce the present high mortality of cholecystectomy.

Choice of Anæsthetic.—Loss of consciousness during operation in patients with coronary disease is a decided help to their circulatory system. The majority, if conscious during the operation, develop signs of shock. Cold, clammy perspiration, dimunition in the volume of the pulse, and faintness are not uncommon phenomena. Vascular "accidents" (cerebral and pulmonary thrombosis, embolism, etc.) are more prone to occur as the result of using nitrous oxide rather than ether, hence the prolonged administration

of the former to patients with coronary disease is not advisable. A light narcosis produced by ether is more satisfactory. Ether in moderate amounts is a cardiac stimulant, and even in the presence of marked myocardial degeneration does no appreciable harm.

SUMMARY

1. A clear conception and early recognition of heart failure are necessary in the appraisal of the coronary surgical risk.

2. Appraisal of the hypersensitiveness of the central nervous system is essential to an accurate interpretation of the gravity of the symptoms in coronary disease.

3. Reduplication of the first apical sound indicates ventricular hypertrophy on the verge of failure.

4. Arterial degeneration in the muscles of the legs may mask advanced myocardial degeneration.

5. Women are superior to men as surgical risks.

6. Adequate venous return to the heart during an operation is a necessity in a patient with coronary disease.

7. Transfusion of whole blood is the most effective method to prevent and combat surgical shock.

8. Without transfusion cholecystectomy in a male with coronary disease is hazardous.

9. The prolonged administration of nitrous-oxide and oxygen is not advisable in patients with arterial degeneration.

10. Ether is the most satisfactory anæsthetic for patients with myocardial degeneration.

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ASSOCIATION OF HYPERTHYROIDISM WITH DIABETES

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The association of diabetes with hyperthyroidism is by no means of rare occurrence, although one would be inclined to think so from the sporadic reports in the literature which give but little indication of the actual incidence of this combination of diseases. For this reason, and because it illustrates the importance of an early recognition of the onset of diabetes in these cases, I am reporting here the case of a patient in whom severe hyperthyroidism preceded the onset of diabetes by nearly a year. In this case such a severe stage of diabetes developed that the patient became extremely emaciated. The hyperthyroidism and severe myocarditis persisted even after both lobes of the thyroid gland had been removed, these conditions disappearing only after the removal of a little nodule of thyroid tissue which clinically was about the size of a small marble. When I first saw him this patient was a mere skeleton, too weak to lift his arm, with a basal metabolic rate of about plus 70 per cent., and a blood sugar content of about 400 mg. per 100 c.c. The important feature in this case was that the diabetes was masked, for though glycosuria was present, yet the fasting blood sugar first was at the normal level, a finding which emphasizes the fact that a fasting blood sugar estimation is not a true criterion for the early diagnosis of diabetes; a blood sugar estimation two and one-half hours after a heavy carbohydrate meal being a far better routine procedure.

Case.—The patient was an unmarried man, thirty-three years of age. There was no significant item in the family history. Of the usual diseases of childhood he had had measles, mumps, whooping cough, and chickenpox. He had also had a Neisserian infection. Aside from these diseases he had been in good health until the early part of 1925, when he first noticed that he was gradually becoming increasingly nervous and later that his eyes were becoming increasingly prominent. A gradual loss of weight accompanied the development of these symptoms and his neck gradually enlarged in front. He had some dyspnœa and also tachycardia, which was increased by exertion. Two years before he came to the Clinic his weight had been 130 pounds, but when first seen (December 29, 1925) his weight was 115 pounds. His pulse rate at this time was 140, blood-pressure 130/60.

Physical examination revealed a thin, nervous man with a bilateral thyroid enlargement and with marked exophthalmos. He had a rapid heart which was slightly enlarged to the left, but there were no thrills, shocks or friction rubs and no murmurs. Otherwise the physical examination revealed nothing of importance, excepting paralysis of the left vocal cord with great œdema of the arytenoid on that side and also some affection of the right cord (false cord). The subsequent course of this patient can best be followed by an examination of Table I and of the charts given in Figs. 1–5.

In this case we were dealing with a very severe case of hyperthyroidism presenting all the cardinal symptoms, the high basal metabolic rate persisting

even after a second lobectomy. At the suggestion of Doctor Marine we instituted the feeding of thymus, which was continued for nearly three months after the second lobectomy without any apparent effect. During this

TABLE I.

Summary of History of Patient with Coincident Hyperthyroidism and Diabetes

Year	Date	Weight	Glycosuria	Blood sugar mg. per 100 c.c.	B.M.R. per cent. +	B.M.R. per cent. −	Operations	24 hr. N. output gm.	Symptomatology
1925	June	130							
	July								Appearance of symptoms of hyperthyroidism—nervousness, exophthalmos, rapid heart, loss of weight.
	Dec. 24	115	neg.		63				First seen at the Clinic.
1926	Jan. 4						Ligation, left		
	Jan. 7						Ligation, right		
	Jan. 10								Discharged from hospital to return for lobectomy.
	April 13		3 plus						Reëntered hospital.
	April 15			73					
	April 30						Lobectomy, left		Pulse irregular.
	May 1		3 plus						
	May 11								Discharged from hospital, second lobectomy to be done later.
	Oct. 19								Reëntered hospital markedly emaciated.
	Oct. 20			258					
	Oct. 22	86		405		3			Diabetic treatment started. See chart.
	Oct. 23								See photograph 1 (Fig. 6).
	Oct. 29	89.5							
	Oct. 30	91							Heart irregular. Arrhythmia.
	Nov. 8	92.5							
	Nov. 18				76				
	Nov. 27				37				
	Dec. 9				63				See photograph 2 (Fig. 6).
	Dec. 29						Lobectomy, right		
1927	Jan. 18	97			70				
	Feb. 9	103.5			75				See photograph 3 (Fig. 6).
	Feb. 24							12.7	
	Feb. 27							13.44	
	Feb. 28						Broke left fibula		Feeding with thymus started.
	March 3							14.3	
	March 7							11.79	Heart irregular. Arrhythmia.
	March 10							11.34	
	March 12				89				
	March 14							9.5	
	March 16				71				
	March 17							7.84	
	March 21							21.	
	March 24							13.03	Serum calcium 12 mg. per 100 c.c.
	March 28							12.01	
	March 31							7.4	
	April 4	115						9.65	
	April 7				27				
	April 11							10.75	
	April 15				43				
	April 21							14.64	
	April 25	116.75			71				Heart irregular. Arrhythmia.
	May 1							13.5	
	May 2	111.5					Removal of thyroid nodule		
	May 9	110						4.9	Heart more regular.
	May 16	112						8.5	
	May 25	113.75			16				
	May 31	118						9.8	
	June 9					1			See photograph 4 (Fig. 6).
	June 21								Glucose tolerance test. See chart.
	June 22				9				Heart quite regular, rhythmic and normal in every way.
	June 24	120							
	July 27					3	Infected teeth extracted		Severe reaction due to extraction of teeth, face badly swollen.
	Aug. 29	129							Discharged from hospital.

time, while attempting to open a window, the patient broke his left fibula. Some time after the second operation a small nodule was noted on the right side in the thyroid region. This was removed on May 2, 1927, and was found to consist of thyroid tissue. (See pathological reports.) After the removal of this portion of thyroid tissue, the patient began to improve markedly; the basal metabolic rate promptly became normal and remained so; the heart quieted down and he began to gain strength. The outstanding features in this case are that: The hyperthyroidism preceded the onset of diabetes by nearly a year. The patient first noted the symptoms of thirst and polyuria in September, 1926. Glycosuria had

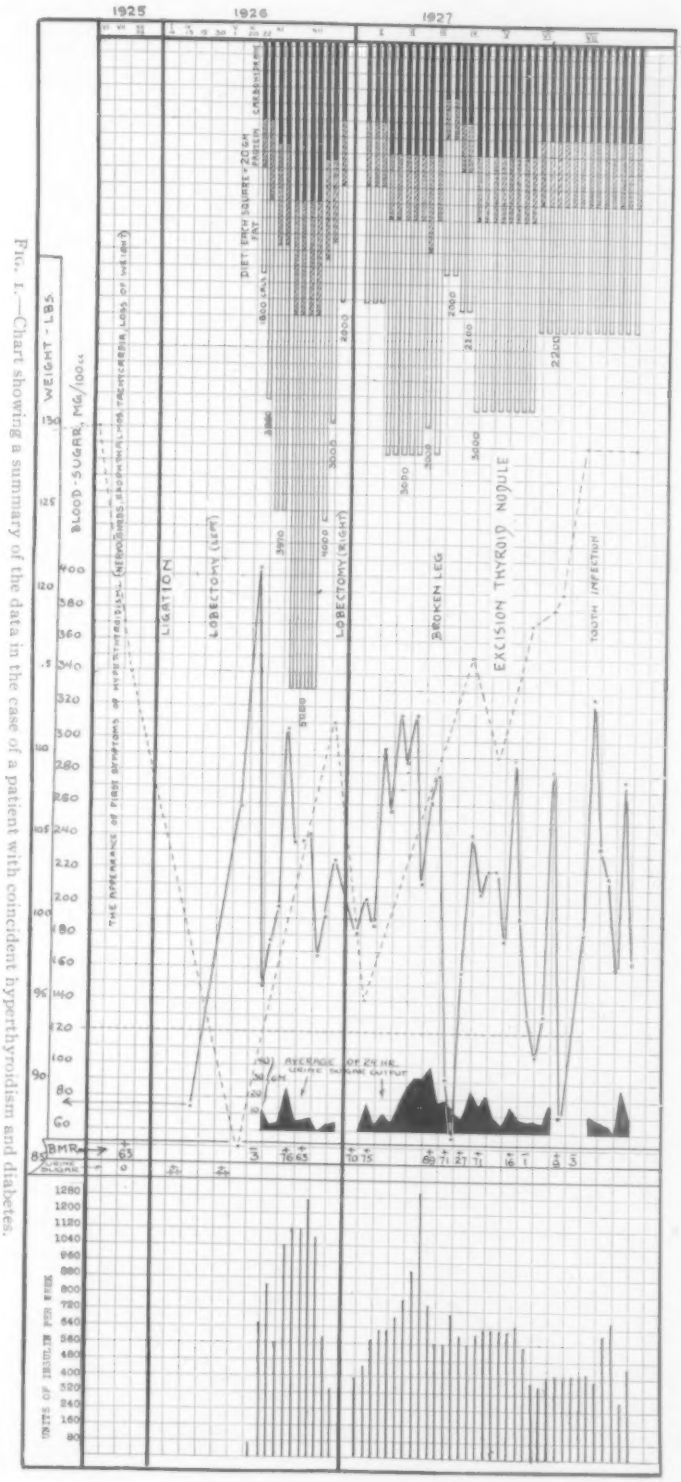


FIG. 1.—Chart showing a summary of the data in the case of a patient with coincident hyperthyroidism and diabetes.

been discovered five months before, in April, 1926, while he was in the hospital, just before his first lobectomy, but on the following day his fasting blood sugar was only 73 mg. per 100 c.c. so that the presence of the glycosuria was disregarded, since this is a common finding in cases of hyperthyroidism. Glycosuria was again found on May 1, 1926, shortly before the patient was discharged from the hospital after the first lobectomy, but was again disregarded. When the patient reëntered the hospital for his second lobectomy he had had the symptoms of thirst and frequency of urination for about six weeks, he was markedly emaciated, his weight having dropped to 86 pounds (see Photograph A in Fig. 6), and he was extremely weak and exhausted. The morning after his admission his fasting blood sugar was 258 and two days later it was 405 mg. per 100 c.c.

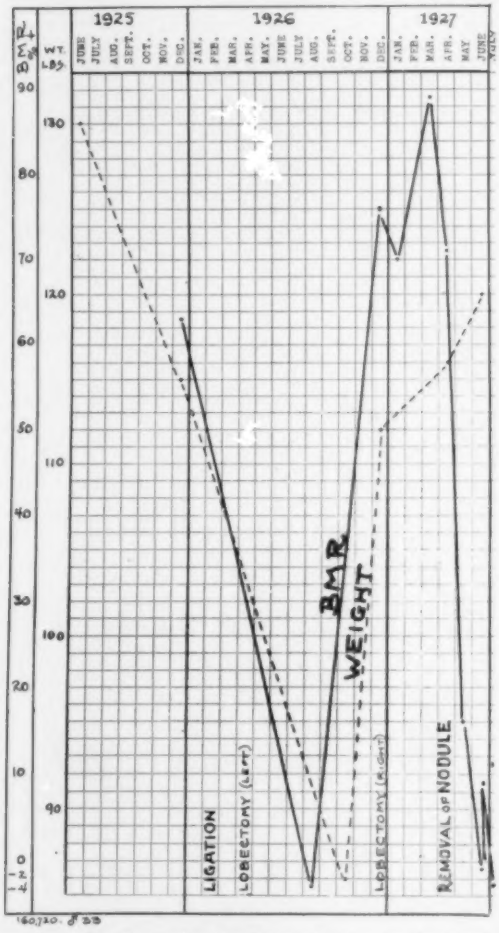


FIG. 2.—Chart showing the variations in the basal metabolic rate and in the weight of a patient with coincident hyperthyroidism and diabetes.

The lesson one can draw from the above history is that glycosuria in hyperthyroidism cannot be disregarded, and that even a fasting blood sugar will not always tell the story, for it masked the true situation in this case. A blood sugar determination made two and one-half hours after a meal might have revealed the diabetic condition, and a glucose tolerance test certainly would have done so.

The problem which was before us in October, 1926, was two-fold: (1) the diabetic condition must be controlled, and (2) the patient must be prepared for a second lobectomy. The man was given large amounts of insulin daily (see Figs. 3 and 4) and began to improve immediately, as is shown by Photograph B in Fig. 6, which was taken less than two months later. During this period his weight had increased from 86 to about 95 pounds. He grew very hungry and his diet was increased from 1800 to 3000 calories, but this did not seem to satisfy his hunger, so that it was further increased to 4000, and finally to 5000 calories before his appetite was satisfied. Even on this high diet (200 gm. carbohydrate, 140 gm.

protein) on many days there was no sugar in the 24-hour specimen of urine (see Fig. 1). On one day the sugar output was 50 gm., but most of the time it was only 5 or 6 gm. in 24 hours, which indicated that the man was utilizing his food, as was shown also by his steady gain in weight. The

TABLE II.

Observations of Pulse Rate of Patient with Coincident Hyperthyroidism and Diabetes

Year	Date	Pulse average	Operation
1925	December 29	80	
1926	January 1	120	Ligation, left.
	January 7	109	Ligation, right.
	April 12	130	
	April 19	125	
	April 26	95	Lobectomy, left.
	October 19	145	
	October 26	90	
	November 2	100	
	November 9	100	
	November 16	100	
	November 23	110	
	November 30	130	
	December 7	120	
	December 14	120	
	December 21	130	
	December 28	120	Lobectomy, right.
1927	January 1	150	
	January 8	110	
	January 15	110	
	January 22	100	
	January 29	120	
	February 5	110	
	February 12	110	
	February 19	110	
	February 26	115	
	March 5	120	
	March 12	100	
	March 19	95	
	March 26	100	
	April 2	100	
	April 9	95	
	April 16	95	
	April 23	95	
	April 30	100	
	May 7	130	Nodule of thyroid tissue removed.
	May 14	95	
	May 21	90	
	May 28	90	
	June 4	90	
	June 10	85	
	June 17	90	
	June 24	82	

average sugar output did increase in 1927, when the patient was on a much lighter diet. Once the craving for food was satisfied, we were able to cut down the diet considerably until, when he was finally discharged, he was receiving 2200 calories (carbohydrate, 120 gm.; protein, 80 gm.; fat, 155 gm.) and three daily doses of insulin of 10, 20, and 20 units, respectively.

When the patient was first here he had tachycardia, and his heart was enlarged to the left; and later murmurs, arrhythmia, reduplication of sound and œdema developed. Digitalis and Lugol's solution did not seem to improve the condition of the heart until after the final nodule of thyroid tissue had been removed, when the whole situation changed rapidly and the heart rapidly improved. (Table II.) I am adding here the notes made by Doctor Anderson, who has been examining the man periodically; and also the electrocardiogram. (Fig. 7.)

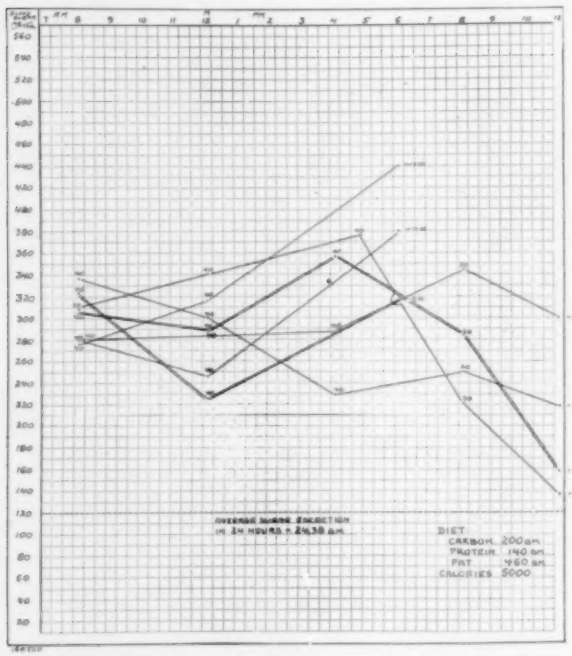


FIG. 3.—Chart showing the blood-sugar fluctuations on six successive days in the case of a patient with coincident hyperthyroidism and diabetes, while he was on a diet of 5000 calories. Insulin dosage is given above dots which indicate height of blood-sugar.

"December 12, 1925: Pulse 140. Heart enlarged to left, no thrills, shocks nor friction; no murmurs.

"December 16, 1926: Heart regular, pulse 132. Left border in anterior axillary line.

"March 5, 1927: Pulse 138. Heart enlarged. Systolic murmur with a reduplicated sound.

"April 13, 1927: On digitalis and Lugol's solution since above note. Pulse 94. Faint systolic murmur at apex. No signs of failure except that feet are slightly swollen.

"June 22, 1927: Heart normal in size, rate 80, no murmurs can be elicited. No failure signs, except that the ankles are still œdematous."

PATHOLOGICAL REPORTS (FIG. 8)

"April 30, 1926: First lobectomy.

"*Gross Description.*—One lobe of the thyroid weighing 65 gm. on section presented a moderately firm but rather colloid appearing cut surface.

"*Microscopical Description.*—Sections through the gland showed it to be composed of enlarged acini lined for the most part by slightly to moderately proliferating cuboidal epithelial cells, which in several instances were thrown into papillary folds. There was relatively slight colloid content throughout.

"*Pathological Diagnosis.*—Rather moderate hyperplasia.

"December 29, 1926: Second lobectomy.

"*Gross Description.*—Specimen consisted of a portion of thyroid tissue, weighing 15 gm., 40 x 25 mm. It was deeply lobulated, fairly firm and on section presented a pinkish-gray, glistening surface.

"*Microscopical Description.*—Sections showed follicular hyperplasia with infolding of acinar walls which had papillary projections into the lumina. Lining cells were columnar in type. In some areas the acini were small, lined with broad columnar cells and had no secretory product in the lumina.

"*Pathological Diagnosis.*—Moderate hyperplasia.

"May 2, 1927: Nodulectomy.

"*Gross Description.*—Specimen consisted of a portion of thyroid tissue, weighing 35 gm., and measuring 70 x 30 mm. It was deeply lobulated, flabby and had a dark red, moist cut surface.

"*Microscopical Description.*—Sections showed follicular hyperplasia and infolding of acinar walls, which were lined with columnar epithelium. The stroma was scanty and showed distinct lobular markings.

"*Pathological Diagnosis.*—Slight hyperplasia."

GENERAL DISCUSSION

In Table III I have summarized cases of coincident hyperthyroidism and diabetes which I have found in the literature, including therein my own

TABLE III.

Cases of Coincident Diabetes and Hyperthyroidism Reported in the Literature

Author	No. of cases	Total series of cases of hyperthyriodism	Outcome		Year
			Cured or improved	Dead	
Dumontpallier	1				
Brunton	1			1	1867
Hartmann	2				1874
Budde	2				1878
Manges	1				1891
Müller	2				1899
Thompson	3	80			1906
Sattler	56 (from literature)				1906
Crile	1			25	1909
O'Day	4		1		1915
Rohdenburg	2		4		1916
Fitz	9	1800 (Mayo Clinic) 315 (Mass General Hosp.)	2		1920
Holst	10 (glycos.)		10 (by thyroidectomy)		1921
Cammidge	1		1		1921
Buchanan	1		1		1923
Charvat	1		1		1924
John	40	3171	38	2	1926 1927

series which is to be reported elsewhere. For about two years I have been making a special study of the carbohydrate metabolism in such cases of hyperthyroidism as showed, (1) glycosuria, (2) fasting blood sugar above normal (120 mg. per 100 c.c.), or (3) blood sugar above normal two and one-half or more hours after a meal. This study has consisted chiefly in the study of the glucose tolerance in these cases and basal metabolism estimations. Of the 93 cases of hyperthyroidism which have been included in this study, in forty the glucose tolerance curve was not normal, that is, the curve did not return to the normal level within two and one-half hours after the ingestion of 100 grams of glucose. In a normal individual the curve returns to the normal level within one or one and one-half hours. In some of these cases the height and length of the curve showed a frankly diabetic condition to be present.

It is somewhat difficult to interpret the borderline curves—that is, those which are not frankly diabetic in character but nevertheless do indicate some disturbance of the carbohydrate metabolism. One may consider that they indicate an impairment of the insulogenic function which may be and often is corrected when the hyperthyroidism is controlled, by whatever means; yet, if uncared for, these cases may drift into a diabetic stage, as I have seen happen in a few cases. I am inclined to consider these as cases of functional diabetes" in which the condition may be corrected under appropriate treatment. In some cases a normal status is reëstablished without treatment, but since no one can say in advance in which cases this will happen, the only safe procedure is to institute an anti-diabetic regimen. Glycosuria is not an infrequent finding among cases of hyperthyroidism. The presence of glycosuria in itself alone is not, by any means, a proof of a diabetic state, but it does indicate the need of further investigation. In hyperthyroidism we are dealing not only with the normal renal threshold to which blood sugar must rise before it can appear in the urine, but also with the fact that in some cases of hyperthyroidism the renal permeability is increased, an increase which Allen has described as being of toxic origin. I have noted this phe-

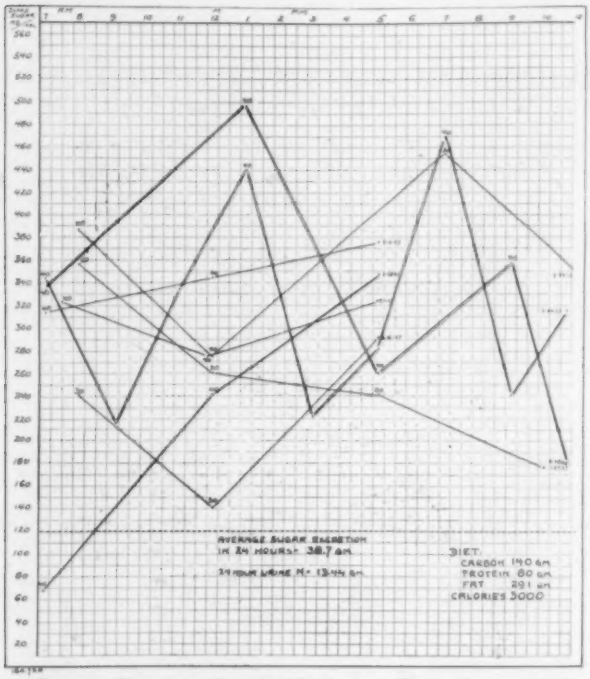


FIG. 4.—Chart showing the blood-sugar fluctuations on eight days during a period of five weeks in the case of a patient with coincident hyperthyroidism and diabetes, while he was on a diet of 3000 calories. The insulin dosage is given above the dots which indicate the height of the blood-sugar.

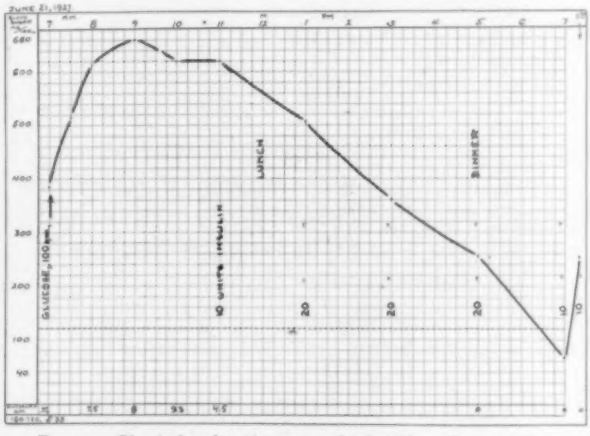


FIG. 5.—Chart showing the curve obtained in a glucose tolerance test made June 21, 1927, seven weeks after the final operation, in a case of coincident hyperthyroidism and diabetes.

nomenon by comparing glucose tolerance tests made during the acute stage of hyperthyroidism with those made from four to six months after thyroidectomy. This comparison has shown that the sugar excretion during the

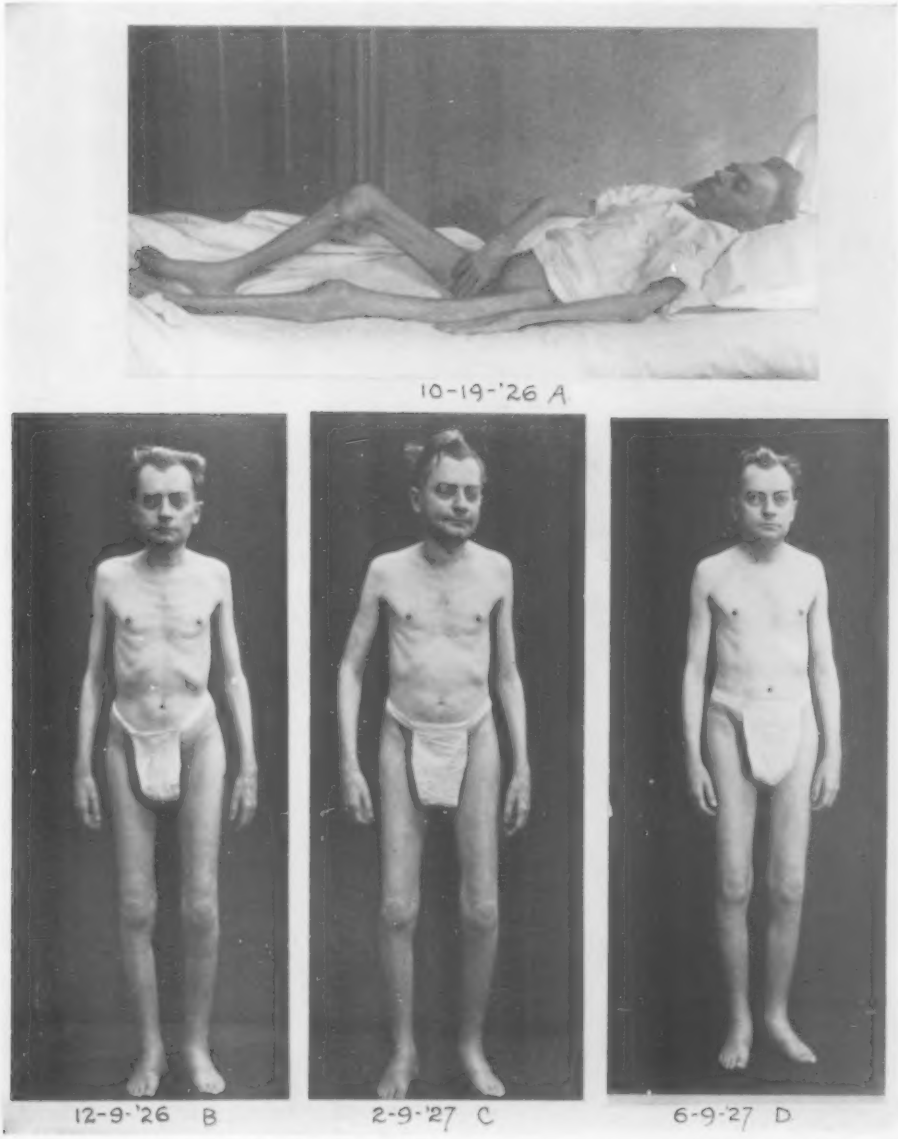


FIG. 6.—Photographs of patient with coincident hyperthyroidism and diabetes. A, photograph made at the time of the discovery of the diabetic condition; B, C, after treatment with insulin had been instituted; D, one month after the final operation.

acute stage of the disease was much larger than after the thyroidectomy, though the coincident blood sugar curves were identical. Increased renal permeability is evidenced by high incidence of a low renal threshold in cases of hyperthyroidism as compared with that in average run of cases. (Table IV.)

As one studies the relationship of diabetes to hyperthyroidism, it becomes

quite evident that in the majority of cases hyperthyroidism precedes diabetes, and a study of the carbohydrate metabolism in these cases leads one to think that hyperthyroidism must be one of the predisposing factors in the development of diabetes. This does not mean, however, that the most severe cases of hyperthyroidism are most predisposed to diabetes, for apparently that is not the case. In a very severe case of hyperthyroidism the glucose tolerance may be quite normal, while a patient with mild hyperthyroidism may be frankly diabetic. It seems rather that hyperthyroidism is simply a factor which is sufficient to precipitate the onset of diabetes in individuals who, we may say, are already on the road to diabetes, so that the coincident occurrence of any other factor such as infection, overeating, etc., would have the same influence. It is a well known fact that patients with hyperthyroidism consume an enormous amount of food, to compensate for the increased metabolism, and they thus throw a heavy burden on the insulogenic function of the islands of Langerhans which, if already weakened, will easily become exhausted, with resultant diabetes. Years ago von Noorden [3] called attention to this fact.

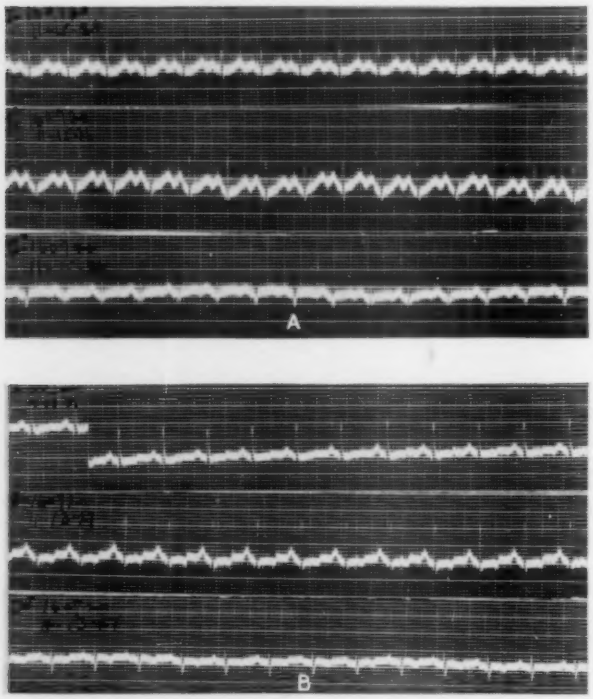


FIG. 7.—Electrocardiographic tracings made in a case of coincident hyperthyroidism and diabetes. A, tracing made November 15, 1926, before the second lobectomy; B, tracing made April 12, 1927, before final operation—removal of a small nodule of thyroid tissue.

CONCLUSIONS

1. Personal observations and cases reported in the literature lead to the conclusion that the association of diabetes with hyperthyroidism is not a

TABLE IV.

Renal Threshold in 73 Cases of Hyperthyroidism and Simple Goitre as Shown by Glucose Tolerance Tests

Blood sugar mg. per 100 c.c.	60–70	71–80	81–90	91–100	101–110	111–120	121–130	131–140	141–150	151–160	161–170	171–180	181–190	191–200	201–210	211–220	221–230	231–240	241–250	251–260	261–270	271–280	281–290	294
Number of cases	3	3	0	6	3	11	7	4	4	7	5	4	1	1	3	2	4	1	1	1	1	0	0	1

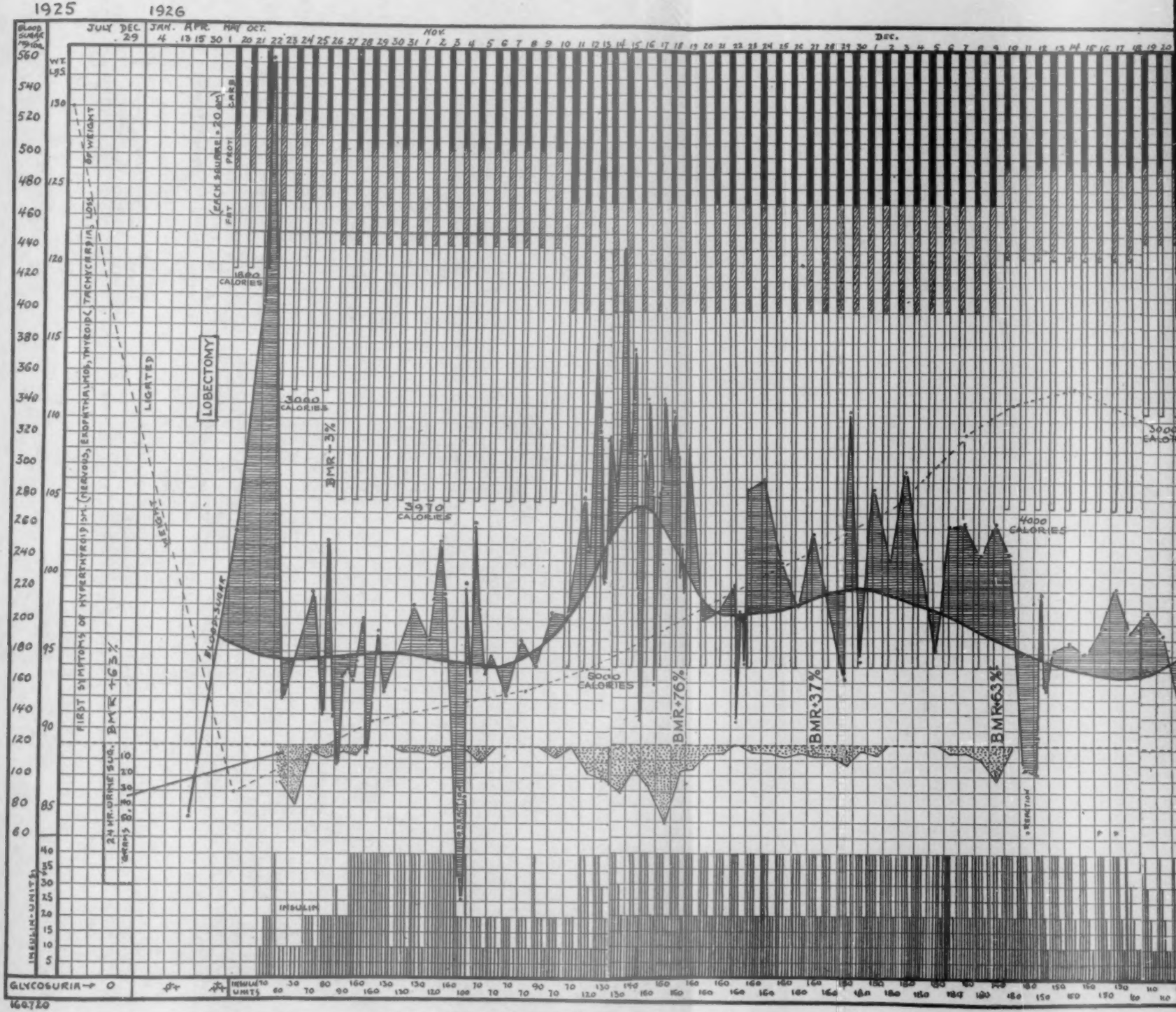
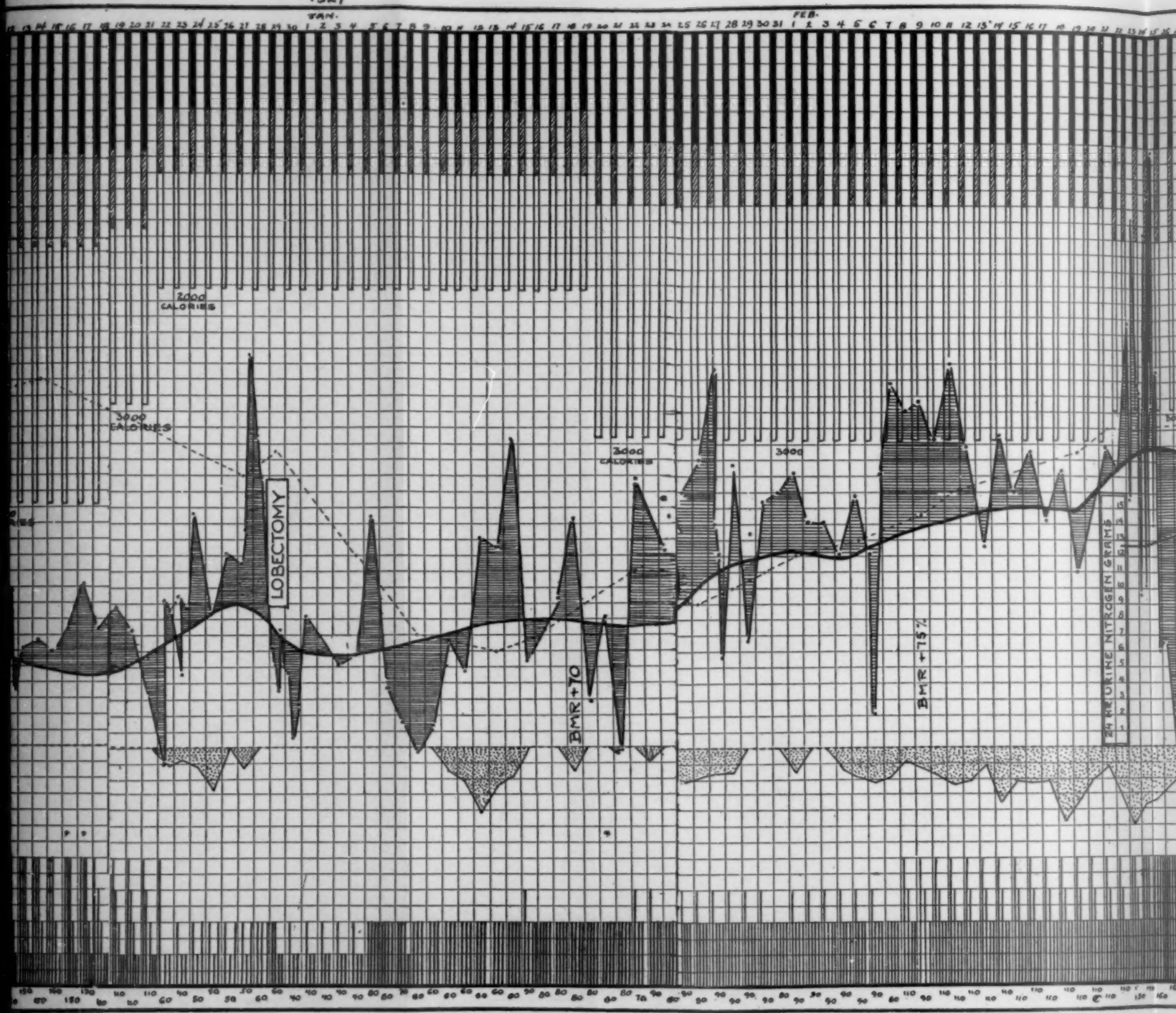
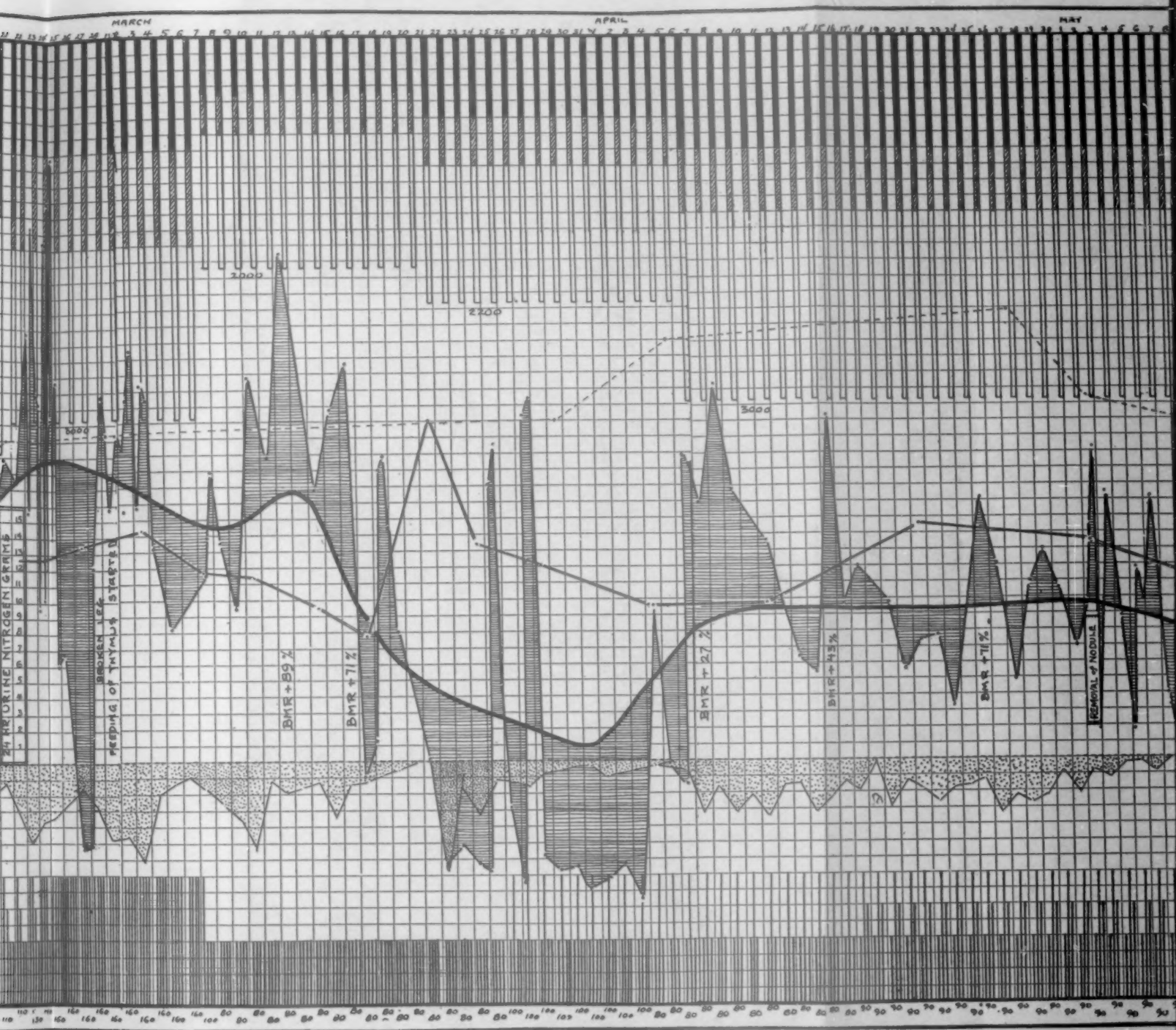


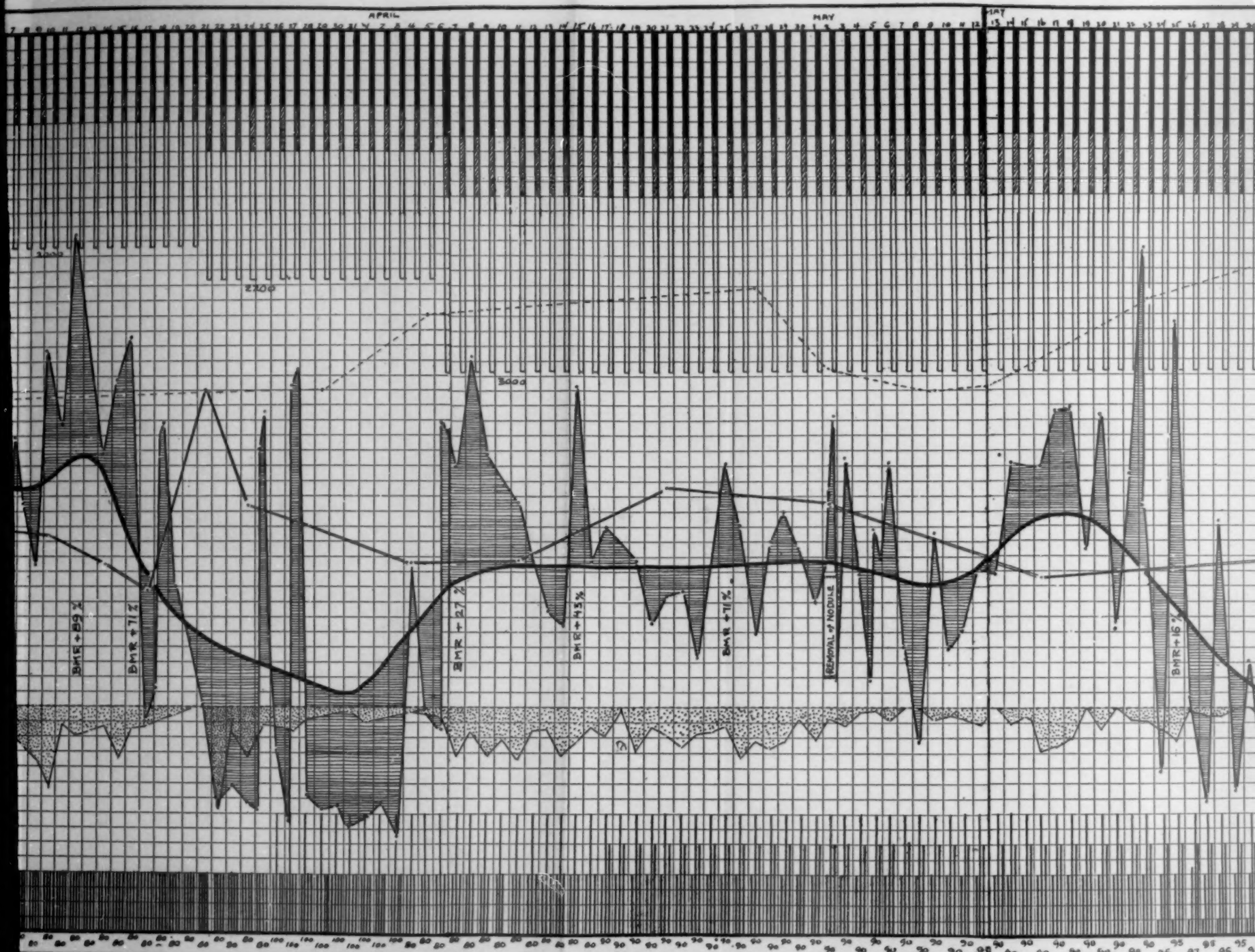
FIG. 9.—Chart showing daily data and progress in the case of a patient with coincident hyperthyroidism and diab



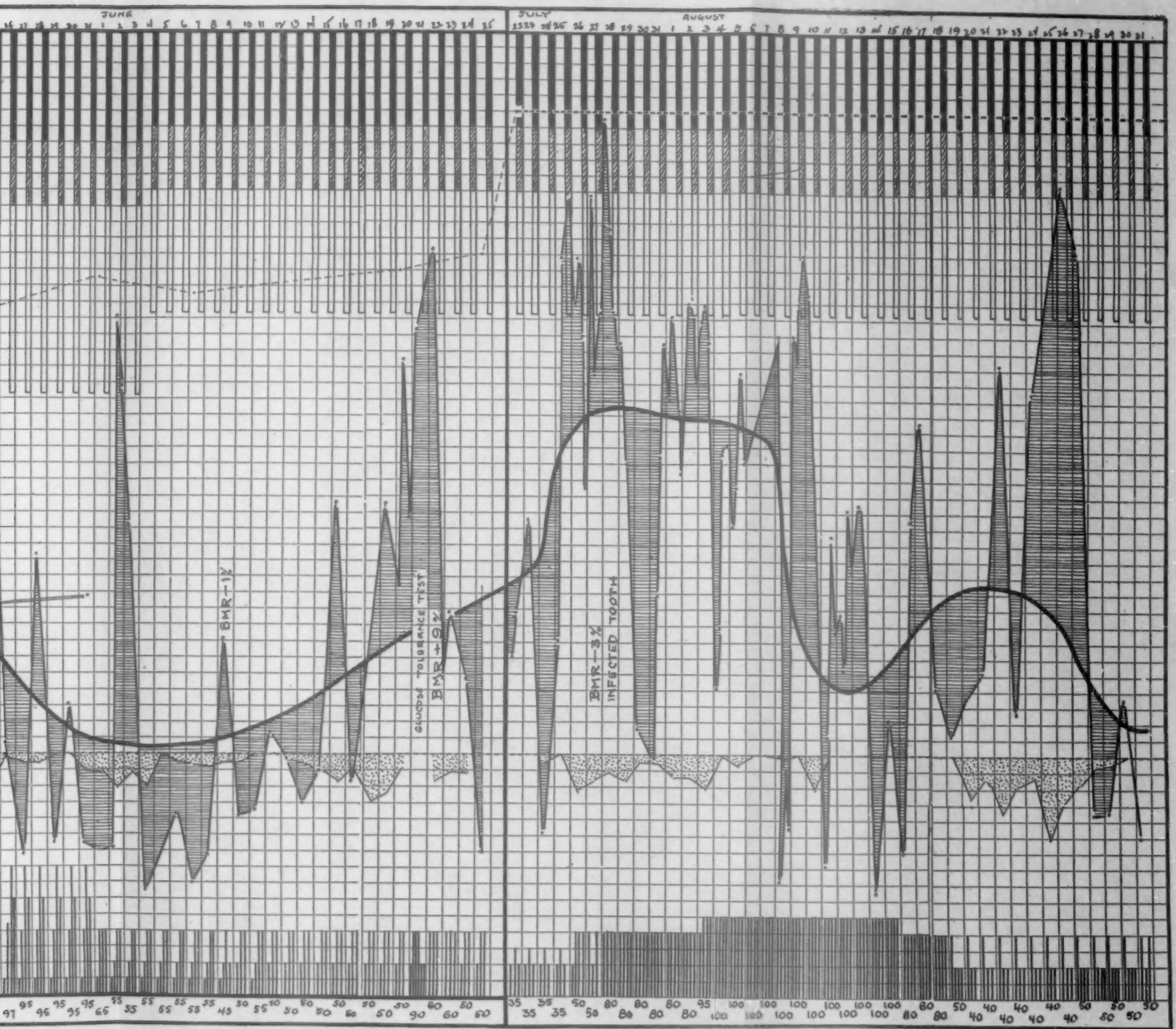
hyroidism and diabetes. The diet is shown at the top of the chart in long columns, the black portion representing the carbohydrate, the shaded portion the protein,



the protein, and the clear portion the fat. The fluctuations in the blood-sugar during each day are shown in a heavy black line, intersected by dots which show the a



the fat. The fluctuations in the blood-sugar during each day are shown in a heavy black line, intersected by dots which show the actual readings. The scale is given on the left side o



e left side of the margin. The insulin dosage is indicated in the vertical column at the bottom of the chart.

rare occurrence; and that when this association does occur the diabetes usually develops after the onset of the hyperthyroidism.

2. The appearance of glycosuria in a case of hyperthyroidism should never be disregarded, but a blood sugar determination two and one-half hours after a heavy carbohydrate meal or else a glucose tolerance test should be made in order to determine whether or not the glycosuria indicates a diabetic or prediabetic status.

3. The treatment of diabetes associated with hyperthyroidism does not vary from the treatment of diabetes without this complication, with the

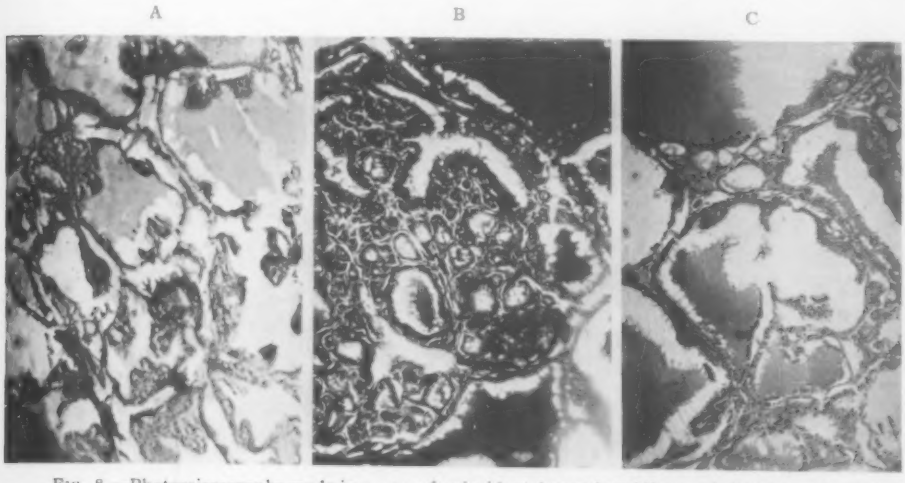


FIG. 8.—Photomicrographs made in a case of coincident hyperthyroidism and diabetes. A, section from specimen in first lobectomy; B, section from specimen in second lobectomy; C, section from specimen of nodule removed in final operation.

exception that, because of the increased metabolism in cases of severe hyperthyroidism, a diet of much higher caloric value than the usual diabetic diet is necessary, and consequently much more insulin is required.

4. Thyroidectomy improves carbohydrate tolerance in all cases of diabetes associated with hyperthyroidism in which diabetes is mild in character; in most of these cases insulogenic function is restored to normal status.

Addendum.—The patient whose case is reported in this article returned to the Clinic, July 22, 1927, approximately one month after he was discharged from the hospital, complaining of abscessed teeth. They were extracted and a severe reaction followed, his face becoming badly swollen, etc. There was a marked rise in the blood-sugar for a period of nearly two weeks and the insulin dosage had to be increased, as is usually the case when an infection occurs in a case of diabetes. The basal metabolic rate, however, was not increased and the patient was discharged from the hospital August 29, on the same diet and the same dosage of insulin which he had had before the infection. In Fig. 9 are given the complete data of this case during the three years that the patient has been under observation.

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CONGENITAL CYSTIC DILATATION OF THE COMMON BILE-DUCT*

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Apparently a number of patients have died through failure to recognize congenital cystic dilatation of the common bile-duct in time. According to McWhorter, "the correct diagnosis has not been made in any case prior to operation." Since this statement, however, Neugebaüer claims to have diagnosed a case prior to operation, and eleven other cases have been reported. These, with the case I am reporting here, make a total of sixty. The condition (in my case) was recognized during an exploratory operation when it was noted that the hepatic and cystic ducts emptied into the superior pole of the cyst. McWhorter says that practically all cases in which diagnosis was not made at the first operation terminated fatally. Of the cases reported later, diagnosis was not made at operation in four (Wyllie, Adam, Zimmer, and Hill and Ramsay). The patients of Adam, Zimmer, and Hill and Ramsay recovered after the second operation. Wyllie's patient died. In seven cases the diagnosis was made during operation. Three of these patients recovered, two died, and the outcome is not stated in two. In one, no statement was made as to time of diagnosis; the patient recovered. In the cases in which a primary choledochoduodenostomy has been performed, three patients recovered and two died. In Wagner's case in which cholecystectomy had also been performed, the patient died. Of the fifty-nine cases reported, external drainage was instituted in forty. All but nine of the patients died, McConnell's, and eight who had some form of internal drainage. In many of the fatal cases secondary choledochoduodenostomy had been performed but the patients were too exhausted to recover. If cystic dilatation is recognized, choledochoduodenostomy or other internal drainage is indicated. The use of external drainage in partial or complete obstruction of the common duct, without correction of its cause, invites disaster in this class of cases as well as in other cases of obstruction of the duct.

Case Report.—A boy, aged twelve, was brought to the hospital, October 20, 1922, because of pain in the abdomen. The first attack was six months previously; it improved after treatment for round-worms. In the last few days he had had three more attacks. Calomel and salts were given with temporary relief. No food had been taken by mouth in the last two days because eating caused discomfort. The pain was around the navel and in the right flank, but did not extend to the epigastrium, the back or the bladder region. There was no nocturia or frequency, and no blood or gravel in the urine. The patient had been well until two years ago when he had a nocturnal attack of severe pain, followed by soreness in the upper abdomen which required morphine.

* Read before the Association of Resident and Ex-resident Physicians of the Mayo Clinic, October 6, 1926.

Examination showed a well-nourished boy apparently not acutely ill. Head, neck and throat were negative on examination. The chest was clear to auscultation and percussion. There were no murmurs or arrhythmia of the heart. The abdomen was tender over the right upper quadrant and in the right flank. There was slight tenderness in the region of McBurney's point. The urine was normal except for a trace of albumin and 15 pus cells in a low-power field. The leucocytes numbered 9600. Röntgenogram of the kidney, ureter and bladder revealed no stone. The diagnosis was recurrent appendicitis. Operation was performed through a high McBurney's incision under ether anæsthesia on the day of admission. The appendix and a Meckel's diverticulum were removed. There was a small amount of clear fluid; the appendix was retrocæcal and rigid, especially at the tip, and distended with gas. Lymph-nodes were considerably enlarged in the ileocæcal region, but not elsewhere. About 50 cm. above the ileocæcal valve a Meckel's diverticulum about 3 by 5 cm. was found. The liver margin, gall-bladder and lower pole of the right kidney were palpated and found negative. Convalescence was uneventful and the patient was dismissed from the hospital on the ninth day.

FIG. 1.—Congenital cystic dilatation of common bile-duct containing 400 c.c. bile.

The patient was readmitted July 5, 1926, complaining of severe pain in the right upper portion of the abdomen. The present illness began about one month after his dismissal from the hospital, October 29, 1922. He had attacks of pain in the pit of the abdomen followed by soreness in that region. They were not referred to the back. Morphine was necessary for relief. He was nauseated and does not vomit except after hypodermics. Between attacks he suffered no discomfort and could eat anything. There was no belching of gas or high fever with attacks. He had never been jaundiced. The bowels were regular and stools were never white. On examination the patient was found to be well-nourished, vigorous and alert. His color was good, and the pupils equal and reacting to light and accommodation. The tonsils were diseased. The teeth showed moderate caries and pyorrhœa. The abdomen was moderately distended with tenderness and rigidity in the upper right quadrant. No mass was felt at first but following an enema, a smooth tender mass about 7.5 cm. in diameter, moving with respiration, could be palpated in the upper part of the abdomen in the region of the gall-bladder. The urine was normal. The leucocytes numbered 6800. The temperature on admission was 100°, the pulse rate 98, and respiration 20. The tentative medical diagnosis was empyema of the gall-bladder or hydrops, liver cyst, stone in the right kidney, and chronic intestinal obstruction. The pre-operative diagnosis was hydrops of the gall-bladder.

Operation was performed July 6 under ether anæsthesia through a high right rectus incision. A small solid gall-bladder was found, but there was no evidence of stone. There was a large bulging, post-peritoneal, cystic mass between the spinal column and the right kidney and extending beneath the duodenum which reached its highest point on the anterior wall of the cystic mass. The mass extended to the hilum of the right kidney and above to the juncture of the cystic duct with the hepatic. Numerous large vessels could be seen running over the cyst. Extension was greater to the right side of the common duct. The cyst wall was yellowish-white, tough, thick, and fibrous. Owing to its extension to the hilum of the kidney there was some question whether or not it might be hydronephrosis, but that was ruled out by aspiration of bile with a hypodermic needle. An effort was then made to dissect out the cyst, but owing to marked hemorrhage and mobilization of the duodenum it could not be removed with safety. The cyst was evacuated of 400 c.c. of fairly normal looking bile through a trocar. The sac was then opened, finger introduced for examination, and an ineffectual effort made to find the opening into the duodenum. The wall on the inside was smooth and no stone was present. The cystic duct was normal in size and could be readily seen entering at the upper end of the cyst. The hepatic duct was not dilated. The cyst began at the juncture of these two ducts. Judging from the position of the cyst beneath the duodenum, the distal end of the common duct must have entered the duodenum from the right to the left.

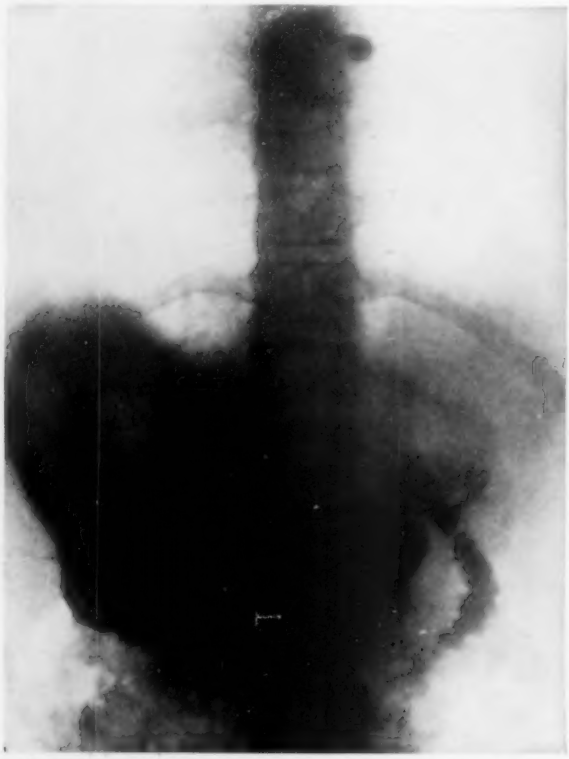

FIG. 2.—Röntgenogram made two months after operation, showing potency of lumen of choledochoduodenostomy.

The liver was smooth and normal in appearance; its edge was thin. The gall-bladder was small and apparently contained no bile, although it was not opened. After failure to deliver the cyst, it was thought best to attach its wall to the duodenum in order to promote internal drainage, so a choledochoduodenostomy was done with a 2-cm. opening into the lateral wall of the second portion of the duodenum with two rows of extra hard catgut without clamps. The duodenum was opened and the duodenal and stomach contents aspirated. The material removed showed considerable bile, indicating that there was still some opening through the common duct. Culture made from bile showed no growth. The wound was closed in the usual manner with two small rubber tissue drains below the gall-bladder near the site of the choledochoduodenostomy. The patient made an uneventful recovery and left the hospital twenty-one days after the operation.

September 9 the patient returned at our request for a Graham-Cole study of the gall-bladder and barium meal test for patency of the stoma of the choledochoduodenostomy and outline of the cyst. He stated that he had been free from all previous

symptoms. The Graham-Cole test was carried out by giving seven capsules of kerasol by mouth, and a röntgenogram made twelve hours later failed to show a shadow of the gall-bladder or any unabsorbed capsules. The barium outline of the stomach showed it to be low, with a normal duodenal cap. The duodenum observed fluoroscopically gave a faint shadow passing upward in the region of the choledochoduodenostomy, and the films showed a rounded area lying in the region of the common duct superior to the duodenum. This was thought to be a remnant of the former cystic dilatation of the common bile-duct.

Fifty per cent. of the patients were children under fifteen and only 10 per cent. were more than twenty-five years old (Table I). There were nine males and fifty females. The sex was not stated in one case.

TABLE I.

Treatment, Type of Operation and Results

	Patients		
	Total	Living	Dead
Not operated on	5	0	5
Drainage only	29	2	27
Drainage and later anastomosis attempted	4	0	4
Extirpation of cyst and drainage. Bile-ducts ligated in one	3	0	3
Choledochojejunostomy	1	1	0
Choledocho-enterostomy following drainage	1	1	0
Choledochoduodenostomy primarily	5	3	2
Drainage and choledochoduodenostomy at second operation	6	6	0
Cholecystostomy and hepaticoduodenostomy with excision of sac and cholecystectomy	1	1	0
Drainage, secondary choledochojejunostomy and enterostomy	1	1	0
Cholecystojejunostomy and drainage; second operation, drainage of tumor	1	1	0
Drainage; second operation cholecystoduodenostomy, third operation choledochogastrostomy	1	1	0
	58*	17	41

*These figures are incomplete as only a short abstract of Yamanouchi's article was available (cystic duct, hepatic duct, gall-bladder and liver; operation and outcome omitted.)

The usual symptoms were recurrent attacks of jaundice, upper abdominal pains and palpable cystic tumor occurring during childhood or early adolescence. McWhorter states that jaundice was absent in three cases. It was never present in my case.

The size of the tumor varied from about 8 to 45 cm., and the contents varied from 200 c.c. to 8 litres. Concretions or incrustations were present in ten cases. The patent lumen in the terminal portion of the common duct was not mentioned or demonstrated in twenty-one cases but was reported present in thirty-six; it was thought to be present in three. In one of these bile was present in the duodenum but no jaundice, only slight jaundice in another, and no jaundice in the third. There was narrowing of the lumen in eleven. There was valve formation at the juncture of the cyst with the duodenal end of the common duct in eight cases. There was a sharp kink or angle in ten cases and no apparent cause of obstruction in seven. Hill and Ramsay state, " It seems clear, therefore, that in all recorded cases there

has been obstruction to the outflow of bile; that the obstruction is partial and intermittent; that the obstruction tends to progress, all patients not operated on having died. While most observers take it for granted that the cyst is congenital, does it not seem far more likely that the obstruction is the congenital anomaly, and the cystic dilatation merely secondary to this, comparable to a hydronephrosis produced by chronic partial obstruction to the urinary outflow?" This explanation seems much more logical but still does not explain the intermittance of attacks nor those cases in which symptoms began between the ages of ten and twenty. Associate duodenitis grafted on a congenitally narrowed duct may explain some of the late cases.

FIG. 3.—Röntgenogram showing size of cystic dilatation two months after operation. Patient free of symptoms.

The cystic duct was normal in ten; dilated in twenty-two; valve-like formation above, obliterated, narrowed and kinked, respectively in four; dilated in the lower half in four; thickened and elongated in one, and not mentioned in seventeen. The gall-bladder was normal in nineteen cases, dilated in twenty, small in nine, and not mentioned in ten. It was palpated as an independent tumor in six cases. The hepatic ducts were dilated in thirty-three cases; normal in four, thickened in one and not mentioned in twenty. The liver was normal in fifteen cases, enlarged in five; it showed hepatitis in three, cirrhosis in seventeen and icterus in one; it was not mentioned in seventeen.

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CHOLANGITIS FOLLOWING CHOLECYSTENTEROSTOMY*

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Since cholecystenterostomy was first practiced by Winiwarter [39] in 1880, it has become a useful method of providing for the escape of bile into the intestine in the presence of an irremovable obstruction in the terminal end of the common bile-duct. Following the more frequent direct attack upon the common duct for obstructions due to calculi, cholecystenterostomy has lost an indication for which it was earlier frequently performed. To-day, the procedure has its best indication in the treatment of obstructive jaundice due to compression of the common bile-duct by carcinoma of the head of the pancreas. Its performance as a method for establishing internal drainage for chronic infections of the biliary system was supported by J. B. Murphy [28] and is advocated by Deaver.[6] Babcock [2] has suggested the extension of the employment of cholecystogastrostomy to the treatment of gastric ulcer and obstinate hyperacidity or pylorospasm not relieved by conservative means.

In the performance of cholecystenterostomy the union is made by choice with the stomach, duodenum or jejunum. In Winiwarter's [39] case both the small intestine and the colon were employed in an attempt to effect a fistulous communication. After six operative procedures an opening between the gall-bladder and colon was established and a seventh operation was necessary to close the fistulæ in the colon and jejunum through which bowel content discharged upon the abdominal wall. In 1887 Monastyrski [25] and Kappeler [13] each performed cholecystenterostomy in one stage; Monastyrski selected a loop in the upper jejunum for the anastomosis with the gall-bladder, while Kappeler employed the lower ileum. To-day, cholecystogastrostomy or duodenostomy is the operation usually done when circumduction of the bile into the intestine by a new route becomes necessary. An anastomosis with the jejunum, permitting of the performance of an entero-anastomosis in the jejunal loop proximally is favored by a few. In the latter method a retrocolic union of gall-bladder and jejunum as first practiced by Prendl,[29, 30] and later by Brentano,[4] permits of the establishment of the communication with the intestine at a higher level. At one time, the Murphy button was frequently used to effect the union, but at the present time in the performance of cholecystenterostomy, the suture method is most widely employed.

Early in the history of the operation, the danger of ascending infection of the bile-ducts was much discussed. Winiwarter [39] had employed the colon for the anastomosis in his case because of the lack of an accessible loop of small intestine at the first operation. In 1894, Michaux [23] reported the instance

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of a patient on whom Ricard had performed cholecystoduodenostomy for obstructive jaundice. No mention of the nature of the obstruction was made. Numerous calculi were found in the gall-bladder. The patient made a satisfactory convalescence at first and the jaundice disappeared after the operation, but four weeks later chills and fever developed. Fifty-three days after the cholecystoduodenostomy had been done she succumbed to the cholangitis. No post-mortem examination was made. Dujardin-Beaumetz,[7] though making no special mention of having observed the complication of cholangitis after anastomosis of the gall-bladder and upper intestine, warned against its performance because of the danger of subsequent infection. Maragliano,[19] in 1903, stated that Fedor Krause for years had employed the jejunum in effecting the anastomosis with the gall-bladder and performed an entero-anastomosis between the afferent and efferent jejunal loops below to minimize the danger of infection. According to Kausch [15] the same procedure had been in practice at the Mikulicz Clinic for several years. Montprofit [26] recommended and performed a jejunal anastomosis with the gall-bladder en Y much in the manner of the Roux gastro-enterostomy to obviate the complication of ascending infection. Krukenberg [17] twisted the gall-bladder spirally with the same purpose in mind in effecting a direct anastomosis of the gall-bladder with the jejunum. Cholin [5] employed an anastomosis en Y in the manner of Montprofit but twisted the jejunal loop that went to the gall-bladder.

In 1924, Lehman [18] stated that "The surgeon confronted with a permanently blocked common bile-duct and an available gall-bladder hesitated to employ the present operation of cholecystogastrostomy or cholecystenterostomy on account of the probability of the ultimate development of liver infection". In only a few of our text-books on surgery is there any mention made of the danger of cholangitis following cholecystenterostomy. Rowlands and Turner [36] stress the possibility of its occurrence and refer to the case of Ricard.[23] Moynihan [27] says, "To open the small or the large intestine is to give opportunity for infection to spread into the gall-bladder and thence to the liver." In his experience it is never necessary to choose any other part than the stomach or duodenum for the anastomosis.

Babcock [2] states that he has not observed a single instance of clinical secondary infection of the biliary tract in 130 cholecystenterostomies performed by himself and his associates. Mayo-Robson,[21] in one of his early cases in performing a cholecystojejunostomy, made an entero-anastomosis after the method described by Maragliano between the afferent and efferent loops of the jejunum, but only with the point in mind of obviating obstruction of the bowel in consequence of the angulation of the intestine caused by the anastomosis. Following an experience with the operation of cholecystenterostomy in 64 instances he believed the danger of infection to be minimal. Kehr,[16b] although having had a patient die of cholangitis and infection of the liver seven months after cholecystogastrostomy had been

done for carcinoma of the pancreas causing obstructive jaundice, believes the factor of subsequent infection to be of no great concern. In 1913, he had done 60 cholecystenterostomies. Bardeleben,[3] who had considerable experience with the procedure, was also of the opinion that the danger of subsequent infection is slight. In 1906, Bardeleben had done 25 cholecystenterostomies. When he notated his experiences with the method, all instances in which the operation had been done still survived save where the procedure had been performed for obstructive jaundice caused by malignancy. One case was alive and well twelve years later. Bardeleben [3] stated that a dilatation of the bile-passages accompanied by hypertrophy of the walls occurred, together with an hypertrophy of the gall-bladder mucosa and a catarrhal inflammation of the bile-ducts. But he had not observed an instance of cholangitis after union of the gall-bladder and bowel.

In the case of Ricard reported by Michaux,[23] the patient apparently had had occasional rises of fever accompanied by chills before the cholecystenterostomy was done. Inasmuch as no statement is made concerning the nature of the obstruction, the cholangitis that followed in this instance may have been due to an obstruction of the common bile-duct by a calculus. In view of the previous history of chills and fever this is probably the more likely. Such an instance is also reported by Helferich [10] when cholangitis followed a cholecystojejunostomy for a stone in the common bile-duct that was not removed.

But in addition to the undoubted case of Kehr [16b] referred to above, where suppurative cholangitis developed and caused the patient's death seven months after a cholecystogastrostomy had been done for carcinoma of the head of the pancreas, two other instances of cholangitis following cholecystenterostomy have been noted by Kausch.[15]

In the case of a fifty-eight year old woman with obstructive jaundice, Kausch did a cholecystojejunostomy and performed an entero-anastomosis between the jejunal loops. One month later when the jaundice had disappeared, he reoperated with the idea of doing a radical excision of the head of the pancreas. At this operation, yellowish areas thought to be metastases were observed on the inferior surface of the left lobe of the liver. Biopsy of the head of the pancreas only was done and the abdomen closed. The biopsy showed pancreatitis. Three months later jaundice and cholangitis caused the patient's death. At necropsy, a purulent cholangitis was found. There was no evidence of carcinoma.

The other instance was that of a man of forty-nine who had been jaundiced six weeks. At operation Kausch [15] found an operable carcinoma of the terminal end of the common bile-duct. A cholecystojejunostomy with an entero-anastomosis was done. Two months later when the jaundice had disappeared, the patient was reoperated and the terminal common bile-duct with a portion of the head of the pancreas the size of a walnut was excised, together with the upper two-thirds of the duodenum. The common bile-duct was ligated and implanted into the distal portion of the duodenum. The pylorus was occluded and a posterior gastro-enterostomy was done. Bile and pancreatic juice drained from the wound for seventeen days. The patient was able to return to work. Traces of bile were occasionally present in the urine, and the skin

always remained rather dark. A few months later, there was a gradual return of the jaundice and bile could constantly be demonstrated in the urine. Operation was advised but refused. Nine months after the first operation the patient died of cholangitis and cholemia despite a final cholecystostomy. At necropsy, suppurative cholangitis was found. The cholecystenterostomy opening barely admitted a small probe. There was no recurrence of the tumor or evidence of metastasis.

The establishment of an entero-anastomosis between the units of the jejunal loops employed in effecting the union of gall-bladder and intestine failed to obviate the occurrence of cholangitis in these two instances. As a result of this experience Kausch has suggested an added precaution in doing cholecystenterostomy for pancreatitis or operable carcinoma of the pancreas causing obstructive jaundice. He recommends dividing the jejunum about 50 cm. (20 inches) below the duodenojejunal angle. Both ends of the bowel are inverted. The distal jejunum is drawn up and anastomosed side to side with the gall-bladder. A lateral anastomosis is then made between the jejunal segments. The loop of jejunum anastomosed with the gall-bladder is then plicated to narrow the lumen of this channel and to diminish the danger of ascending infection. This is really an anastomosis en Y with a slight modification of Montprofit's [26] and Cholin's [15] methods.

Four years ago the complication of cholangitis following cholecystoduodenostomy was observed in a patient on whom the procedure was performed for malignancy of the head of the pancreas causing obstructive jaundice. A recapitulation of the significant events in that case is the subject of this report.

C. R., Hospital No. 23,856. Male, age fifty-four, was admitted to the University of Minnesota Hospital,† July 7, 1922, with the complaint of painless jaundice of three months' duration. For some time antedating the jaundice, patient had noticed failing strength and up to admission had lost 25 pounds in weight. He has had no chills nor fever nor any abdominal pain. Stools have been acholic for the last two months. Appetite has been poor and patient has been unable to work for about six weeks. No previous operations.

Physical Examination.—Patient is moderately emaciated and very deeply jaundiced. Liver extends about 2 inches below the right costal margin. Apart from the liver margin, a mass, fairly movable and not tender, can be made out. The mass is about the size of a lemon and is thought to be the gall-bladder. Chest and heart negative. Weight on admission was 116 pounds. Blood-pressure 140/88.

Laboratory Examination.—Stools negative for bile. Fat present in excess. Urine—bile + + + +; occasional granular casts present. Hæmoglobin, 75 per cent.; red blood-cells, 3,700,000; white blood-cells, 10,500; differential normal. Fragility test—hæmolysis began at .40, complete at .20 per cent. NaCl. Bleeding time two minutes; coagulation time six and a half minutes. Blood, Wassermann, negative.

X-ray examination of chest negative for metastatic tumor. Old fibroid tuberculosis at apex of left lung.

Calcium chloride, 5 c.c. of a 10 per cent. solution, was given intravenously on each of three days prior to operation.

† All the operations on the patient were performed by Dr. A. L. Cameron, Dr. A. C. Strachauer, Chief of the Surgical Service, and Doctor Cameron have kindly permitted me to include the report of this case.

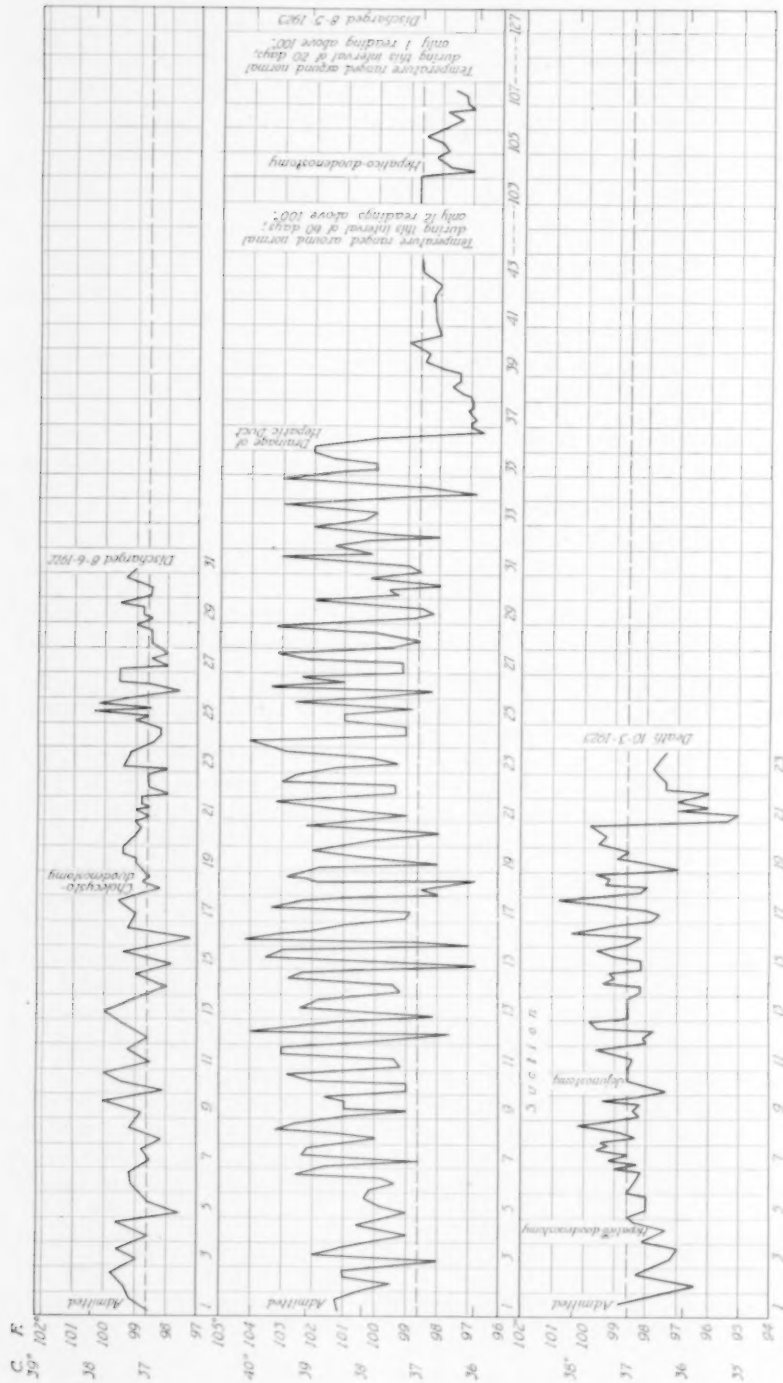

FIG. 1.—The accompanying chart shows temperature variations during the stay of the patient in the hospital on all three admissions. Operative procedures performed are marked on each graph. The length of stay in the hospital in each instance is indicated. The marked fall in temperature following drainage of the hepatic duct on the second admission is apparent.

Pre-operative diagnosis: Carcinoma of the head of the pancreas with obstructive jaundice.

Operation, July 24, 1922. Cholecystoduodenostomy. Ether anæsthesia, right rectus incision. At operation the liver was found markedly jaundiced. The gall-bladder was distended, otherwise normal. Spleen was of normal size. In the curve of the duodenum the pancreas was palpated as a hard nodular mass. No lymphadenopathy in the gastro-hepatic omentum was made out. The cul-de-sac was negative. Gall-bladder was emptied by aspiration. Anastomosis made between the gall-bladder and the second portion of the duodenum by the suture method, two rows of chromic catgut being used anteriorly and posteriorly. Following cholecystoduodenostomy bile appeared in the stools and patient was discharged as improved on August 6, 1922.

March 30, 1923, readmitted with the complaint of chills and fever and abdominal pain. Since his dismissal in August, 1922, he had gained about 20 pounds in weight. The jaundice had disappeared entirely by the first of October and the patient had returned to light work. His condition continued good until about the middle of January, 1923. At this time he contracted influenza and shortly began to have chills and fever accompanied by slight jaundice. Since then his health has gradually declined and he has lost considerable weight again. The appetite has been poor and there has been a daily range of fever in the last month from 100 to 102 degrees.

Examination.—Patient is moderately emaciated and definitely jaundiced. There is moderate tenderness in the upper right quadrant beneath the costal margin. There is an operative scar over the upper portion of the right rectus muscle.

Laboratory Examination.—Stools contained traces of bile. Urine, bile + +; hæmoglobin, 62 per cent.; red blood-cells, 4,164,000; white blood-cells, 22,300. Bleeding time, one-half minute; clotting time, four minutes.

During the next few weeks of observation the patient ran marked elevation of temperature with daily excursions from 99° to as much as 104°.

Diagnosis.—Cholangitis following cholecystoduodenostomy. May 5, 1923. Drainage of hepatic bile-duct under ether anæsthesia. The head of the pancreas was found firm, enlarged and nodular. The common bile-duct was apparently occluded. A catheter was inserted into the hepatic duct. Following this there was an immediate drop in temperature. Patient began to feel better at once, appetite improved and patient was up and around. The temperature was sustained at a normal level save for an occasional rise.

On July 11, 1923, an attempt was made to anastomose the hepatic bile-duct to the pyloric end of the stomach. The fistulous tract present was dissected out with care. An anastomosis was made with the hepatic duct and the pyloric end of the stomach. However, this procedure was not successful and in the next few days bile again escaped from the wound and was continuing to do so when the patient was discharged from the hospital on August 5, 1923.

September 10, 1923, the patient was readmitted and an attempt was made again on September 13 to anastomose the hepatic duct to the duodenum. Due to the obliteration of anatomical planes and to the presence of considerable scar tissue the operation was attended with considerable difficulty. An anastomosis was made between the hepatic bile-duct and the duodenum. Penrose drains were inserted and the abdomen closed.

During the next few days there was considerable drainage of bile and what was thought to be duodenal content from the wound. Suction was applied and on September 19 jejunostomy was done. Patient died on October 30 of peritonitis.

A post-mortem examination was performed by Dr. John F. Noble of the Department of Pathology of the University of Minnesota, through whose courtesy the following report is made available. Only the description of the significant findings are listed.

"On opening the peritoneal cavity it is found to be filled with about 1500 c.c. of fluid purulent material. The coils of the intestine are sealed together by a thick layer of yellow fibrinous material. In the region of the incision in the right upper quadrant there are dense fibrous adhesions. The liver is firmly adherent to the diaphragm by fibrous adhesions. The diaphragm arches to the sixth rib on the left; its place on the right is not determined. Examination of the peritoneal cavity in the region of the incision on the left side shows a sinus opening between the external surface of the abdominal wall and the jejunum near its beginning. The opening is firmly sutured and there is no evidence of leakage. Examination of the biliary tract shows a catheter to have been inserted with its bell end in the hepatic duct. Its opposite end was in the duodenum. The hepatic duct is quite markedly dilated and contains a thick inspissated bile. There is a partial repair of the biliary tract so that the catheter is covered save for a distance of about 3 cm. in length.

The entire dome of the liver is adherent to the diaphragm by dense adhesions. On section the liver tissue is pale and swollen and the markings are indistinct. There is apparently a slight increase in consistence of the organ and the centres of the lobules show slight bile staining. The gall-bladder wall is somewhat thickened and its surface covered with dense fibrous adhesions. When opened there is a small amount of mucoid bile in its cavity. There is no evidence of stones in the gall-bladder or the biliary tract.

The head of the pancreas is firm and nodular and dissection of the common duct as it passes through the head of the pancreas shows the lumen of the duct to be completely obliterated. The gall-bladder is buried in a bed of fibrous adhesions and the cystic duct is also practically obliterated. The anastomosis stoma is considerably narrowed.

On section the head of the pancreas is found to be made up of a gray granular friable tissue. This tissue is well localized in the head of the organ and fairly well defined. There is no evidence of infiltration save in one small regional lymph-node.

The gastro-intestinal tract is negative save for the duodenum which shows a rent on the anterior surface, measuring 2 cm. in diameter. It has been sutured but the suture line has broken down and there is leakage of intestinal content which probably is responsible for the peritonitis.

Microscopically, the lesion in the head of the pancreas is adeno-carcinoma. The common and cystic bile-ducts are invaded by carcinoma.

Diagnoses.—1. Carcinoma of head of pancreas. 2. Diffuse peritonitis. 3. Duodenal fistula. 4. Jejunostomy. 5. Cloudy swelling of heart, liver and kidneys. 6. Operative repair of biliary system (attempted). 7. Obstruction of common (complete) and cystic bile (partial) ducts by carcinomatous infiltration.

Discussion.—When anastomoses between the gall-bladder and the stomach or duodenum are made in the experimental animal infection of the bile-passages usually obtains. Radsiewsky [32] did five cholecystojejunostomies in dogs. A few months later when the dogs were killed bacteria were found in both the extra- and intrahepatic bile-ducts. Radsiewsky described the process as a desquamative catarrhal inflammation. There was no evidence of suppuration.

Hubicki and Szerzynski,[11] according to Kehr, made anastomoses between the gall-bladder and the upper intestine in seven dogs. About a year later when the animals were killed very definite evidence of infection was found in four of the animals. Mocquot [24] did similar anastomoses in five dogs and killed the animals from five months to a year later. Infection was found in the extrahepatic bile-ducts in all. The liver itself escaped infection. Gatewood

and Poppens,[8] in an extensive experimental study of cholecystoanastomoses, state that the bile-passages become infected in every instance in which union of the gall-bladder and intestine are effected. It obtained following union of the gall-bladder with the stomach or duodenum as well as after anastomosis with the colon. Trautmann, Robbins and Stewart [38] obtained results of the same nature in ten cholecystenterostomies performed on the dog. In each instance intestinal content passed directly into the gall-bladder. In 61 per cent. there was evidence of infection in the bile-passages.

When an internal biliary fistula is established by the spontaneous rupture of the diseased gall-bladder into the intestinal tract, Charcot's syndrome of chills and fever accompanied by jaundice due to the ascending infection of the extrahepatic bile-passages frequently follows. This occurrence is the rule after spontaneous union of the gall-bladder with the colon. Following union with the stomach, duodenum or jejunum symptoms usually ensue that necessitate separation of the gall-bladder from the viscus into which it has perforated, closure of the site of perforation and excision of the gall-bladder. Judd and Burden [12] have recently reported a series of 153 internal biliary fistulæ requiring operative relief. Of this number the gall-bladder communicated with the duodenum in 117 instances.

Those who have had a considerable experience with the method in the patient, however, uniformly declare that the danger of infection following cholecystenterostomy is slight. (Bardeleben,[3] Mayo-Robson,[21] Kehr,[16b] Babcock.[2]) Certainly the reported instances of cholangitis after cholecystenterostomy are few.

When the operation is performed for malignancy, however, the rarity with which the complication of cholangitis has been observed, it has been argued, may lie partially in the explanation that such patients do not as a rule survive the procedure long. That the primary mortality is much higher following cholecystenterostomy for obstructive jaundice due to malignancy is well known.[16a, 28, 31] That patients with jaundice due to malignancy do not survive anastomotic operations long has been the experience of most surgeons. In 28 instances reviewed by Kehr in which carcinoma of the bile-ducts or pancreas was present and an internal biliary fistula established by an anastomotic operation, the primary and immediate post-operative mortality was 75 per cent. Mayo-Robson and Cammidge [22] believe that life is not prolonged by any operation in cases where jaundice is due to carcinoma of the head of the pancreas and doubt the justification of its performance.

Rovsing,[35] however, mentions the instance of a patient that survived cholecystojejunostomy for carcinoma of the pancreas causing jaundice fourteen months. An entero-anastomosis was made between the afferent and efferent loops of the jejunum employed in the anastomosis. Kappeler's [13, 14] case survived 14.5 months without apparently developing cholangitis after cholecystoileostomy. His patient was only comfortable for six months fol-

lowing the operation, but there is no indication from the facts stated that he suffered from cholangitis. Spannaus [37] credits Kehr with the assertion that he (Kehr) knew of six instances in which the patients survived anastomotic procedures from the relief of obstructive jaundice caused by malignancy for two years or more without symptoms. When the cholecystenterostomy is done in the presence of a patent common bile-duct, it is well known that the newly established stoma frequently closes.[6, 38] Even when the stoma was patent, Archibald [1] was unable to observe the flow of any considerable portion of bile through the fistulous communication in the presence of an unoccluded common bile-duct, in dogs in which he did cholecystenterostomies and isolated a jejunal segment in which to control the observation. Possibly this tendency for the cholecystenterostomy opening to close when the common bile-duct is not occluded may in part account for the infrequency with which the complication of cholangitis has been observed to follow when the operation is performed in patients with an unoccluded common bile-duct and with non-malignant disease, who survive for long periods of time.

In the instance recorded here in which cholangitis developed after cholecystoduodenostomy, the onset of this complication was preceded by influenza. In the patient reported by Kehr,[16b] in which this complication developed, there was also a history of influenza associated with the onset of the cholangitis. Kehr, however, seems inclined to minimize the significance of the influenza as bearing any casual relationship in his case to the infection of the bile-ducts. No culture of the exudate present in the extrahepatic bile-passages was made in either instance. Suppurative cholangitis after influenza has been observed, however, by Mayo-Robson [20] and Rolleston,[34] though no mention of cultural studies was made. Goodhart [9] refers to a patient with influenza who had rigors and intermittent fever similar to that observed in hepatic abscess. In a patient in whom suppurative cholangitis followed influenza, reported by Remy,[33] cultural study of the exudate showed colon bacilli.

Complete obstruction of the common bile-ducts by carcinoma of the head of the pancreas usually gives rise to an afebrile jaundice. When the obstruction has been incomplete, however, cholangitis has not infrequently been observed. Mayo-Robson [20] and Rolleston [34] mention several instances in which intermittent hepatic fever or suppurative cholangitis were observed in carcinoma of the bile-ducts or pancreas. The instances in which cholangitis has developed spontaneously during the course of obstruction of the terminal end of the common bile-duct by carcinoma of the pancreas, appear to be far more numerous than those few instances in which this complication has been observed following cholecystenterostomy for the relief of the obstruction. In each case, the presence of an incomplete obstruction would seem to be the factor that invites infection.

Following reconstructive procedures for benign stricture in the hepatic or common bile-duct, subsequent attacks of jaundice with cholangitis are

usually synonymous with recurrence of the stricture. The Kehr T tube which can be left *in situ* for a long time in this respect, exhibits a decided advantage over the catheter which slips away before the scar tissue at the site of repair has ceased to contract. If stricture formation reoccurs cholangitis obtains in spite of a functional sphincteric insertion of the terminal common bile-duct into the duodenum. In anastomotic operations in the nature of hepatico or choledochoenterostomy, undoubtedly one of the important factors that operate to prevent more uniform and permanent successes with the method is the tendency for the anastomotic opening to close. Probably, only in the event of obstruction to the flow of bile through the new stoma does the potential infection in the bowel actually become a menace.

SUMMARY

That potential infection is real following cholecystenterostomy is shown by the regularity with which it occurs in the experimental animal. The necessity for operative relief following spontaneous union of the diseased gall-bladder and upper intestine indicates that the procedure is not to be selected for internal drainage of diseased bile passages. The complication of cholangitis in patients following cholecystenterostomy has only infrequently been observed. Those who have had a considerable experience with the method uniformly agree that the danger of subsequent infection is slight. An instance in which this complication was observed is reported. It would appear that narrowing or partial occlusion of the stoma as occurred in this instance following anastomotic operations of the upper reaches of the intestinal tract with the bile-passages is the important factor in determining whether the complication of cholangitis will follow. Cholecystenterostomy is an operation of real value in the treatment of an irremovable obstruction in the common bile-duct.

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CYSTIC LYMPHANGIOMA OF THE GREATER OMENTUM

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Of the cystic lymph tumors of the abdominal cavity those of the greater omentum occur least frequently. Wegner's paper in 1874 was the first comprehensive discussion of lymph-vessel tumors. While there is a large literature concerning this class of tumor in general, cystic lymphangioma of the greater omentum has been only briefly discussed, except in the few special papers on the subject.

Spencer-Wells,[1] in 1890, described a large cystic tumor of the omentum in a child. Schwartzenberger[2] described a case of recurrent ascites of two years' duration in a child four and one-half years of age. At operation a large solitary cyst, filled with yellow fluid and lined by endothelium, was found hanging from the omentum by several pedicles. Outerbridge[3] while operating on a thirty-four-year-old woman for a uterine fibroid found the greater omentum adherent to the uterus and numerous cysts in the region of attachment. These he interpreted as lymph cysts due to inflammatory occlusion of the lymph vessels. Minervini[4] also described a case of lymphangioma of the abdominal peritoneum and greater omentum which after five years caused death from exhaustion. Stillman[5] removed a cystic tumor of the greater omentum, many of the cysts being as large as 6 cm. in diameter, in a case which he had observed clinically for years. Borchers[6] described a case of progressive enlargement of the abdomen in a four-year-old child caused by a huge cystic tumor of the greater omentum. Kahuschkin's[7] case presented cysts of the omentum, which he interpreted as cystic lymphangioma. At the autopsy of a fifty-year-old man, Henke[8] found a cystic peritoneum and omentum. He diagnosed the condition as lymphangioma but Merkel considered it pseudomyxoma peritonei. Karas[9] found a multicystic tumor of the right half of the omentum at the autopsy of a thirty-eight-year-old woman. He believed that the cysts were embryonal in origin and were developed from misplaced peritoneal cells. Himmelheber and Kirchberg[10] described a case of multiple cysts of the peritoneum in a fifty-one-year-old woman. The cysts were most numerous in the greater omentum, and the lesion was interpreted as either a lymphangioma or a lymphangio-ectasia.

We recently observed a cystic tumor of the greater omentum in a man forty-four years old. His illness dated back for a few months before admission to the hospital on March 29, 1926. The chief complaint during this time was pain in the left lower quadrant of the abdomen and some rather indefinite symptoms referable to the gastro-intestinal tract. The physical examination on admission to the hospital was negative except for diffuse tenderness throughout the abdomen, particularly in the lower quadrants. The temperature was 98.4° F. The white blood-cell count was 14,000 with 86 per cent. polymorphonuclear leucocytes, 11 per cent. lymphocytes, 1 per cent. transitionals and 2 per cent. eosinophiles. There were 4,512,000 red blood-cells. The urine examination was negative.

At operation a large cystic mass was found attached to the under surface of the liver and the intestines. This mass was apparently the greater omentum. It was dissected as completely as possible from its attachments. The viscera and the rest of the peritoneum were apparently negative.

Pathology.—Gross.—The tumor was removed in several pieces. There were two

large cystic masses, one measuring 6 by 7 by 2 cm.; the other mass was irregular and measured 9 by 8 cm. and up to 3 cm. in thickness. In addition there were several pieces of rather nodular, firm and fatty omentum, and several smaller multicystic masses which had evidently been removed separately but which undoubtedly had been connected with the main tumor tissue.

The smaller of the two main tumor masses was very cystic, and only a small amount

FIG. 1.—Showing most of the tumor mass with several of the larger and smaller cysts exposed.

of fat remained on one surface which enabled one to identify it as greater omentum. When this tumor was sectioned liberally, it was found to consist of hundreds of single and communicating cysts which measured from 1 mm. to 2 cm. in diameter. The cyst wall linings were smooth and the walls for the most part were less than 1 mm. thick. The cysts were filled with a thick jelly-like material. In the more solid portions of the tissue many tiny spaces were seen which on pressure oozed fluid and gave the gross impression of a soft lymphangiomatous tumor so often seen in the skin.

The larger tumor mass contained much more fat and was therefore easily identified as coming from the greater omentum. On section it showed many large and small cysts. Between the cysts there was a firmer, whitish, œdematous tissue. In this portion of the cystic omentum the larger cysts were more widely separated and their walls somewhat thicker. Several representative areas of the tumor were taken for section. (See Fig. 1.)

Microscopic.—The histological picture varied considerably in the different sections examined. However the sections were sufficiently numerous and the changes sufficiently graded to permit an interpretation of the probable pathogenesis of the lesion. In the more solid fatty portions of the omentum an irregular branching and plexiform dilatation of the preëxisting interlobular lymphatics was the predominating lesion. Some of these lymphatic spaces were empty, while others were filled with a pink-staining, granular, practically acellular material. Flattened endothelium lined these lymph spaces, though in some places there was hypertrophy and piling up of these cells two or three layers deep. At the intersections of these dilated lymph spaces processes were seen extending into the lumens. These processes were covered by endothelium, beneath which there was a connective tissue framework, containing blood-vessels. At such intersections many new lymphatic vessels were also seen. These channels were plexiform, rather narrow, and lined by hyperplastic endothelium, one to four cells thick. Some lymphocytes were seen in the supporting stroma between the channels, which was rather œdematous and contained in addition many leucocytes. Other sections of this tissue showed more intense leucocytic infiltration with granulation tissue on the surface of the omentum where it was adherent to the surrounding tissues. These changes were interpreted as due to dilatation of the preformed lymphatics with secondary proliferative changes and tissue reactions due to the irritation of mild pressure. (See Figs. 2 and 3.) Tissue in which the tumorous nature of the lesion was apparent was found particularly between the cysts. Here there was an undifferentiated mesenchyme in which lymphangioblasts produced in places a granulation-like tissue. In these sections stages of the progressive enlargement and growth of the newly formed lymphatics produced in the granulation tissue were also seen. In addition the tissue showed diffuse leucocytic and lymphocytic infiltration. (See Figs. 4, 5, and 6.)

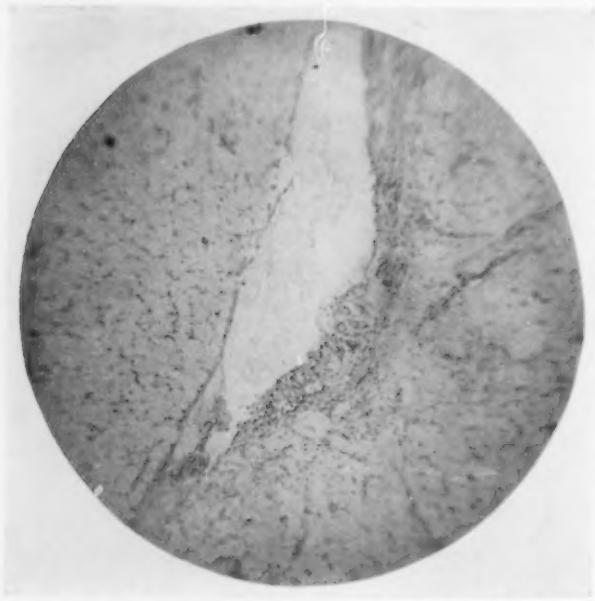

FIG. 2.—A widely dilated preformed lymphatic vessel in the omental fat.

The large cysts were seen in a stroma of loose connective tissue. In the sections most of the cysts were empty while some contained a pink-staining granular material. The larger cysts which measured many low power fields in diameter were lined by flattened endothelium. Both sides of the dividing septa were covered by such endothelium supported by a connective-tissue layer. In the smaller cysts the lining endothelium was either hypertrophied or several cells thick. In some of the cysts there was evidence

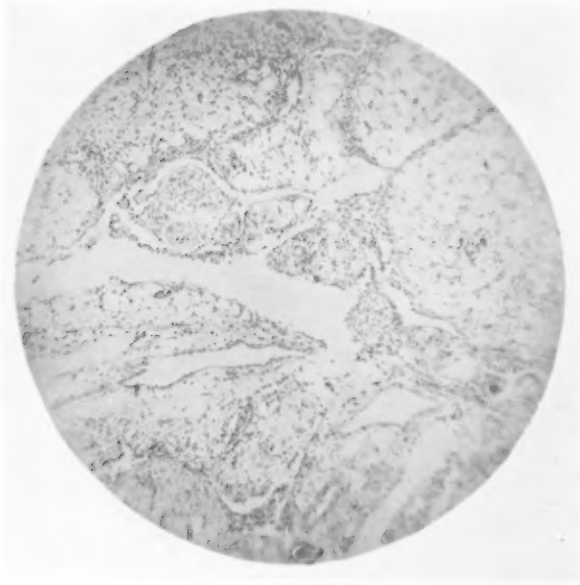

FIG. 3.—Numerous communicating and branching preformed lymphatics with hypertrophied endothelium.

FIG. 4.—Undifferentiated mesenchyme between some larger cysts.

of proliferation with the projection of papillary processes into the lumens. (See Figs. 7 and 8.)

Summarizing the pathological findings, the material removed at operation consisted of most of the greater omentum with very little fatty tissue remaining. There were many small and large cysts. Between these cysts the tissue was either soft, containing many tiny spaces and appearing like the rather soft lymphangiomas of the skin, or the intercystic tissue was somewhat firmer and œdematous. The histological examination of this last tissue disclosed a marked development of new lymphatic channels from what appeared to be a rather indifferent mesenchymal tissue. From these microscopical channels definite stages of lymph channel enlargement were traced. As these channels enlarged, evidences of hypertrophy and hyperplasia of the lining endothelium were recognizable. Where the cysts became very large, the lining endothelium either became flattened or entirely lost. Just beneath the endothelial lining, particularly of the smaller and medium-sized cysts, diffuse lymphoid infiltration was seen producing definite lymph follicles in some places. The preformed lymph vessels of the greater omentum were also dilated, due to obstruction of the efferent channels.

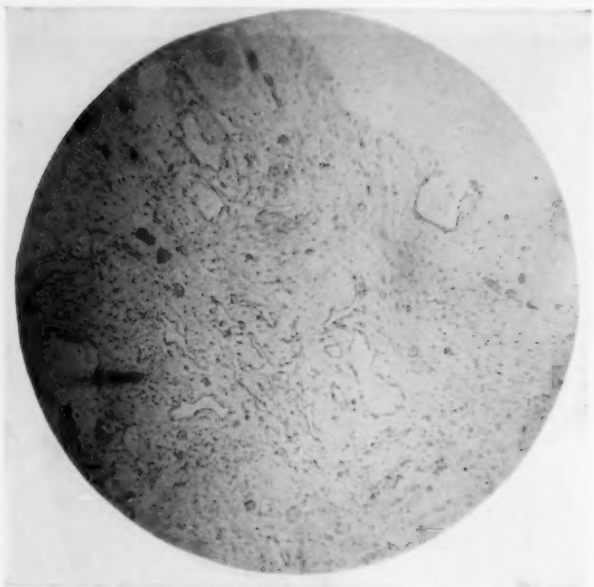

FIG. 5.—The formation of branching lymph vessels in the undifferentiated mesenchyme.

Discussion.—We believe that this case is one of a true tumor of the lymphatics of the greater omentum with certain secondary and obstructive changes that led to its final multicystic form. Although tumors of the lymphatics are divided into simple, cavernous and cystic lymphangiomas, according to their gross and microscopical appearance, genetically they have a common origin. The pathological divisions are not very sharp, for there may be transitions from one group to another. The consensus of opinion at present is that all these angiomas are true tumors of the lymphatic vessels, though some features may be attributed to stasis.

Simple lymphangiomas arise from the lymph spaces and lymph vessels and as a rule they are arranged in an anastomotic network. Cavernous lymphangiomas consist of a framework of connective tissue supporting numerous single and communicating grossly visible cysts filled with lymph.

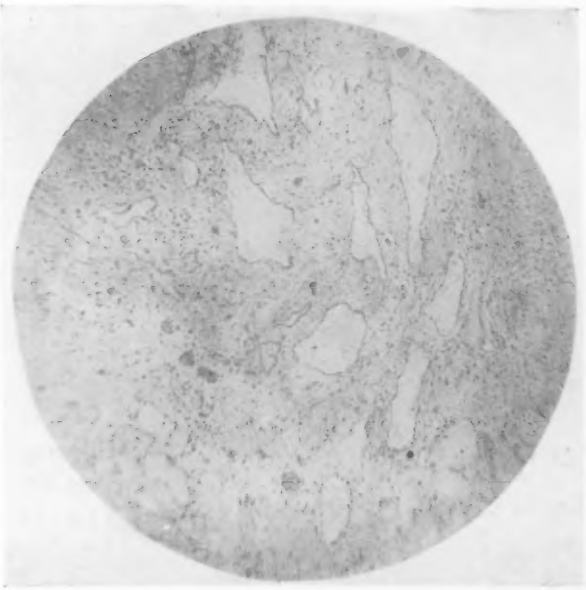

FIG. 6.—Showing the progressive dilatation of the newly formed lymphatic channels.

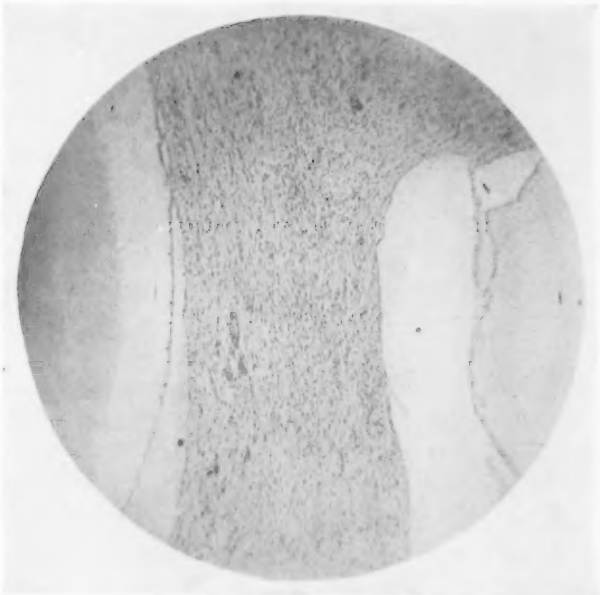

FIG. 7.—A large cyst lined by flattened endothelium.

Under cystic lymphangioma are collected those tumors with a great number of thin-walled convoluted cysts which are filled with lymph or lymph-like fluid, and which are bound together by connective tissue. This stroma contains many smaller spaces which may eventually go on to large cavity formation.

Workers like Nasse,[11] Ribbert,[12], Sick [13] and Henschen [14] have interpreted the origin of cystic omental tumors from embryonally misplaced nests, potentially capable of producing lymph channels, or from post-natally developed connective tissue also having such potentialities. Others have contended that cystic lesions of the omentum, like cystic lesions in other portions of the abdominal cavity, were not tumorous, believing that they arose as a result of stasis of the efferent lymph channels, and that the proliferative changes were due to the irritative effects of the early results of pressure. In support of this contention Wegner's original experiments are usually quoted in which he filled the abdominal cavity with air and continued the increased abdominal pressure for some time. The air entered the subperitoneal lymphatics and the lymphatics of the greater omentum, leading to obstruction of the draining vessels with the consequent production of large cysts with proliferative changes in the walls.

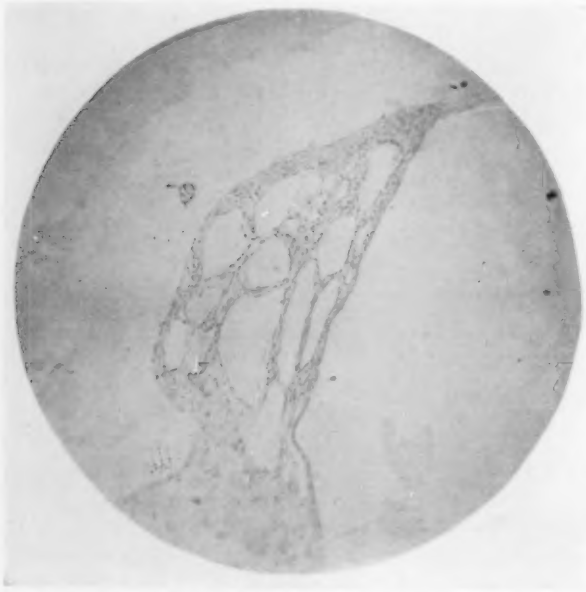

FIG. 8.—Two large cysts with numerous smaller cysts in the connective tissue between them.

On the other hand, Langhans and Ribbert have denied the participation of stasis in the development of these tumors, though others like Borst,[15] Sick and Borchers believe that stasis plays an important but secondary rôle, and leads only to the enlargement of the tumor.

On the basis of our case we believe that the tumor is a true blastoma; that it arises from a mesenchymal connective tissue capable of producing lymphatic channels; that the preëxisting lymph channels of the greater omentum are not involved in the true tumorous proliferation; that if these channels are involved and become cystic, it is due to the obstruction of their lymph flow and that if proliferative changes do occur in their walls, they are due to this obstruction. Many of the new-formed tumorous lymph chan-

nels become obstructed and dilated, though it is conceivable that many, because of their tumorous nature, are blind and become cystic on this account. It is our opinion that while stasis does occur in these growths, it is secondary to the real tumorous nature.

The fluid of these cysts varies in color from water clear to dark brown, and may be of a thin watery to a thick pasty consistency. It is alkaline in reaction, and coagulates on boiling because of its high globulin and albumin content. The sediment shows fatty endothelial cells and cholesterol crystals, though Gödel [16] described the presence of many lymphocytes. No mucin is present in the fluid. The chylous cysts contain a milky fluid which Henschen showed had much in common with chyle on chemical analysis. Undoubtedly lymph seems to be of primary importance in the formation of the fluid content of these cysts, and variations of the cyst fluid from normal lymph are due to factors such as filtration, diffusion, secretory activity of the cyst wall endothelium and degeneration.

This report deals with endothelial lined cysts and excludes all epithelial lined cysts of the greater omentum which may result from embryonic inclusions.

CONCLUSIONS

Another case of cystic lymph tumor of the greater omentum is added to the small number of cases already recorded in the literature. We believe that cystic lymphangiomas are true blastomas arising in the greater omentum from undifferentiated mesenchyme which is capable of producing lymphatic vessels by proliferation of lymphangioblasts. Many of these newly formed lymphatic vessels become enlarged and cystic, due to the blocking of the outlets and possibly because they are blind vessels. Some of the original lymphatic vessels are also obstructed and show secondary changes such as dilatation and proliferation of the endothelium. We believe that the preformed lymphatics are not involved in the tumor growth.

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ABDOMINAL INCISIONS*

THEIR MAKING AND CLOSURE

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of Philadelphia, Pa.

Moynihan says: "I do not think, though much has been written, it is adequately recognized that the steps in the making and in the repair of the abdominal wound are of the very greatest importance. I doubt if it is an exaggeration to say that the circumstances connected with the incision are among the most important in the whole range of abdominal surgery. For, if the incision be improperly made, by free division of muscle fibres and the wilful and unnecessary severing of nerve trunks, a weakened area is left in the belly wall, the result of which may be of even greater severity than the condition which first made operation advisable. Too great care therefore cannot be exercised in the proper choice of a method of incision and of the means of its securest closure. It is a cardinal rule that there shall be no division of muscle fibres unless it is absolutely necessary for a sufficient exposure of the operation field; muscle fibres are to be displaced or separated without injury to nerve supply, never to be cut."

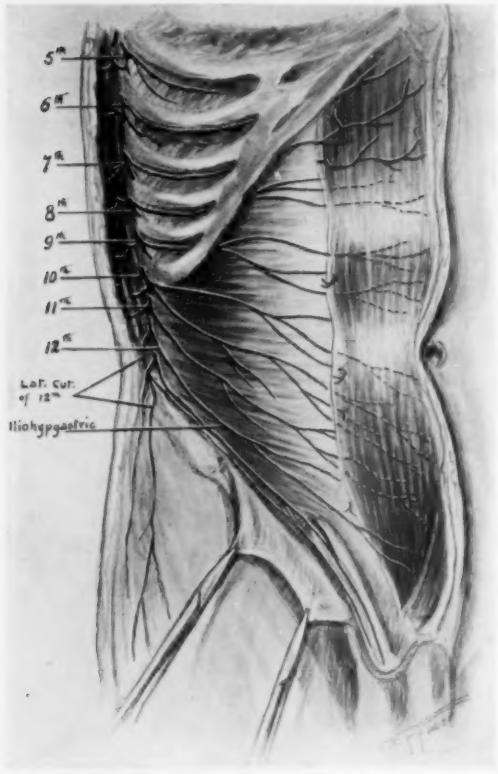

Fig. 1.—Showing nerve supply of muscles of abdominal wall.

I have for some years past been interested in the defects of the abdominal wall, the result of operative incisions, and after observing a goodly number of cases from other clinics I am of the opinion that there is a general tendency to disregard this step in abdominal surgery. By observing a few simple rules it is possible to leave the abdominal wall as strong and free of defects as it was before operation. There are instances, more especially in cases of malignancy, when the operator is justified in sacrificing the structure of the abdominal wall in order to give sufficient exposure. But it is the usual case to which I refer and not these exceptions.

* Read before the Philadelphia Academy of Surgery, October 10, 1927.

It does not seem necessary to go into the detailed anatomy of the abdominal wall for we are all familiar with it, but let us consider briefly the structures which concern us most in the making of an incision. Namely, the muscles, the blood-vessels and the nerves.

The muscles of the abdomen, the three oblique and the rectus on either side have various functions: support of the abdominal viscera, accessory to respiration, aiding in defecation, micturition, and parturition, flexion and rotation of the pelvis and trunk. It is evident then that injury to any of these muscles brings about a disability which may involve one or all of these functions. The oblique muscles should not be cut across but split in the direction of their fibres. This preserves the nerve supply and does the least injury to the blood-vessels. The recti muscles may be cut across without serious damage if properly repaired afterward. It is seldom necessary to cut these muscles as they can be retracted outwardly or inwardly as the case may be. If these muscles are split in the direction of their fibres that portion mesial to the incision will atrophy, its nerve supply having been destroyed. Assmays investigation proved this to be true and I have confirmed his findings. In 3 cases previously operated at other clinics I found at reoperation that mesial portion had disappeared and was replaced by fibrous tissue.

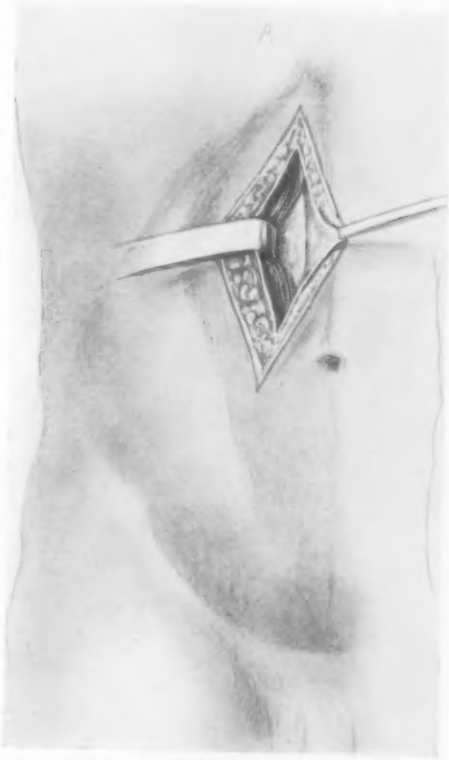

FIG. 2.—Right paramedian epigastric incision, rectus retracted outwardly.

The main source of blood supply to the abdominal wall is from the lower intercostal arteries, the superior epigastric, the deep epigastric and the deep circumflex iliac. The anastomosis is so free that to cut any of them does not bring serious result, but the injury may lead to infection owing to a lessened blood supply.

The motor nerves (Fig. 1) are of the greatest importance. They are eight in number—sixth to twelfth thoracic inclusive, the iliohypogastric and the ilioinguinal. The thoracic nerves are the ones most commonly injured. They run downward and inward between the internal oblique and transversalis muscles, giving off branches to the oblique muscles and terminating in the rectus muscle on its posterior surface near the outer border. It can readily be seen that any incision running across these nerves will sever them.

The resulting defect is not a hernia but a bulging due to paralysis which cannot be cured by surgery.

The incisions commonly used in the upper abdomen and in the pelvis are through the right or left rectus muscle or through the linea alba. As has been previously stated, an incision which splits the recti muscles produces a permanent defect. Midline incisions are defective also in that they give but one facial plane to suture which is insecure and also leads to a diastasis recti. In the clinic of Doctor Ashhurst we use routinely in the upper abdomen and in the pelvis the right or left paramedian incision (Figs. 2 and 3). After opening the anterior sheath of the rectus the muscle is dissected free along its inner border and retracted outwardly. The posterior sheath and peritoneum are opened beneath. The nerve and blood supply are thus preserved. The aponeurotic layers having been cut in different sagittal planes, the securest closure can be obtained. In operations upon the gall-bladder, instead of using the right rectus, the pararectus, the Kocher, or the Mayo-Robson incision, all of which leave permanent defects, we use a right paramedian oblique incision (Fig. 4). It begins across the midline just below the ensiform extending downward and outward across the right rectus to just beyond the linea semilunaris at a point below the level of the umbilicus. The anterior sheath of the rectus is opened in the direction of the skin incision, the muscle is dissected free along its inner border, and lifted outwardly, and the posterior sheath and peritoneum opened beneath in a line parallel to the linea alba. This incision gives ample exposure to the fundus of the gall-bladder and an excellent exposure to the bile-ducts which is of much greater importance. Here again the fasciæ are severed in different sagittal planes.

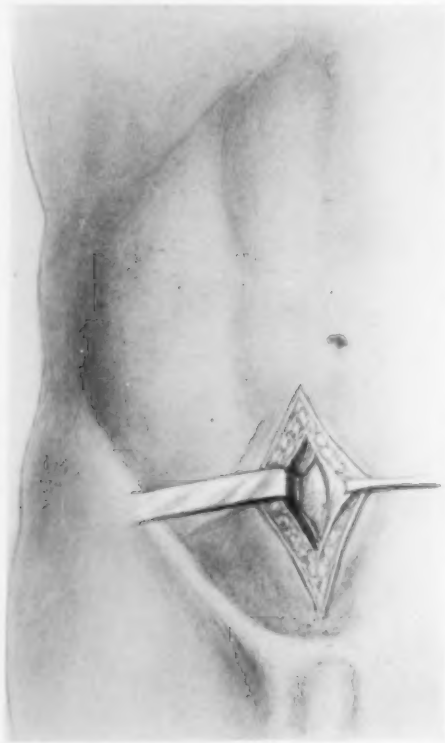

FIG. 3.—Right paramedian hypogastric incision, rectus muscle retracted outwardly.

In operations on the appendix there are several incisions commonly used all of which are open to criticism. The gridiron or muscle-splitting incision of McBurney gives a poor exposure and often has to be enlarged. In so doing it ceases to be a muscle-splitting and becomes a muscle-cutting incision. The pararectus or the incision through the linea semilunaris gives a good exposure, but unless very short it necessarily severs one or more of the thoracic nerves. The same may be said of the incision through the right

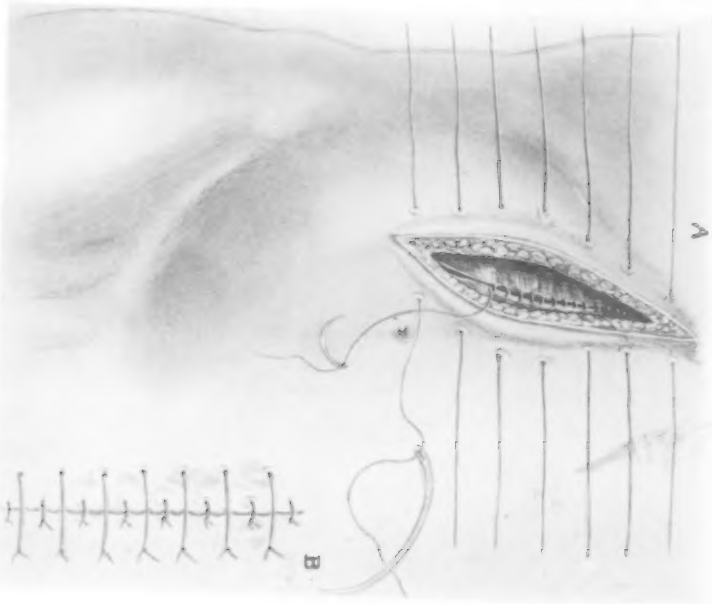

FIG. 4.—*A*. Right paramedian epigastric incision, oblique. Used for surgery of gall-bladder and bile-ducts. Splint sutures in place. Aponeurosis sutured. *B*. Splint sutures tied.

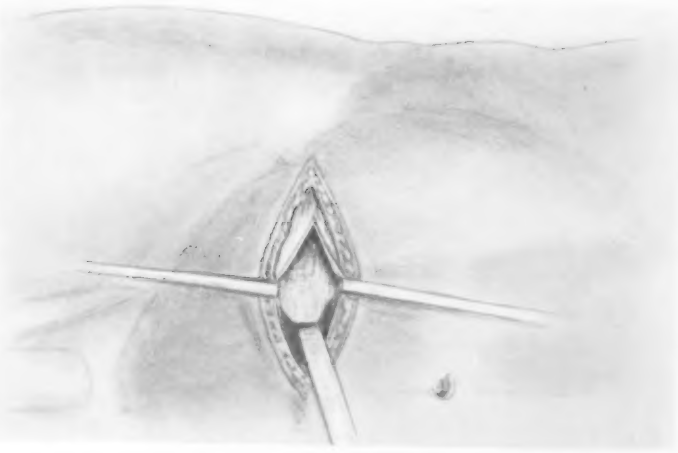

FIG. 5.—Transverse incision of G. G. Davis. Anterior sheath of rectus and aponeurosis of external oblique split. Rectus retracted outwardly.

rectus muscle. The Hancock incision which runs parallel and close to the crest of the ilium above and to Poupart's ligament below, cuts across the bellies of the oblique muscles and often severs the twelfth thoracic and ilio-hypogastric nerve. We use routinely the transverse incision of G. G. Davis (Figs. 5 and 6). It permits excellent exposure and cuts no muscles or nerves. The incision is so uncommonly used, yet has such obvious advantages, that I will give briefly the technic. It is on a line which extends from the anterior-superior spine of the ilium to the linea alba. The incision is usually 6 to 8 cm. long and centres on the linea semilunaris. It may be made at a higher or lower level than this should the appendix be previously located in other than its usual position. The skin and subcutaneous tissues are cut, exposing the aponeurosis of the external oblique and the anterior sheath of the rectus. These are split in the direction of the skin incision and the rectus retracted inwardly, thus putting on a stretch the internal oblique and transversalis muscles which are split outwardly in the direction of their fibres. The posterior sheath is then split transversely inward as far as needed, and the peritoneum opened for the length of the incision. The twelfth thoracic nerve is sometimes encountered running nearly parallel with the incision, but injury to it is obviated by pushing it to one side. When better exposure is needed the incision may be extended outwardly to the anterior superior spine and inwardly to the linea alba. It is never necessary to cut across the rectus, it can always be retracted medially. At a much higher level this incision may be used for operation upon the gall-bladder, but I do not believe it gives as good an exposure as the one used by us which was previously described. On the left side this transverse incision may be used for splenectomy. I have used it in three such cases. Here, however, it is necessary to cut across the rectus in order to get sufficient exposure.

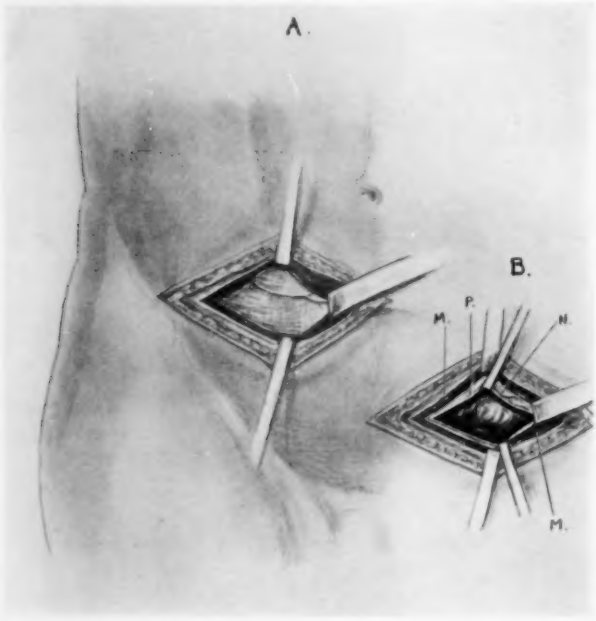

FIG. 6.—*A*. Internal oblique split exposing twelfth thoracic nerve. *B*. Nerve pushed aside—peritoneum opened.

When drainage is necessary it is best to let the drain emerge near the linea semilunaris rather than through the bellies of the oblique muscles.

Muscle tissues held apart by drains tend to remain so after removal of the drain resulting in hernia. The aponeurosis when separated by drains are drawn together by the action of their muscles when the drains are removed. The several hernias I have had following this incision have been cases in which drainage was through the outer angle.

In making any abdominal incision, the cut should be perfectly clean; the edges of the muscles, whether separated or displaced, must be well defined. Fraying of the muscle edges by manipulation is to be avoided, and this can be done by first making the incision of sufficient length, and second, by protection of the wound edges. The length of the incision means nothing if made in the proper way.

To secure proper healing of wounds great care must be taken in closure. The peritoneum and its adjacent fascia are drawn together and sutured with a continuous catgut suture, interrupted sutures if there is much tension, so applied as to evert the edges, thus bringing serous surface to serous surface. This insures prompt union and prevents adhesions between scar and viscera. In all except the transverse incision interrupted sutures of a non-absorbable material, preferably heavy silkworm gut, are placed about 2 cm. apart. These sutures embrace all layers down to the peritoneum. The aponeurotic layer is then sutured with chromic gut. The splint sutures are now tied firmly but not tightly. If too tight they defeat their purpose by strangulating the tissues.

It is customary in some clinics for the operator to push his table aside and have the resident close the abdominal wound while he begins another case. This is bad practice. He who begins an operation should finish it. It is safer for the patient, and should something go wrong, the responsibility can be placed.

Not infrequently one hears of or sees reported cases of breaking down of an abdominal wound with evisceration. It is said that it happens to us all at some time during a surgical career, yet I am of the opinion that it is nearly always preventable. The causes of this calamity may be mentioned in the order of their importance. Faulty making and closure of an incision, constitutional diseases with loss of healing power of tissues, infection, and lastly, the too early removal of splint sutures. These should rarely be removed before the tenth day; usually it is better for them to remain in place twelve days or two weeks.

In conclusion, to secure prompt healing and to leave the abdominal wall free of defects, we must have:

1. Due regard for structures of the abdominal wall.
2. Clean-cut incisions without trauma to its tissues.
3. Perfect asepsis.
4. Secure and accurate suturing of the wound in layers.
5. Not too early removal of the splint sutures.

THE DE PETZ STOMACH AND INTESTINAL SUTURING APPARATUS

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The success of operations carried out within the sphere of the digestive tube depends chiefly on whether we are able to maintain and secure aseptic conditions during our operation.

Although complete asepsis in the most restricted sense of the term is naturally impossible in operations of this character, we nevertheless can achieve relative asepsis by reducing the operating time as much as possible so as to minimize the possibility of infection and by trying to keep all bacteria, and particularly those of the stomach and intestines, away from the abdominal cavity.

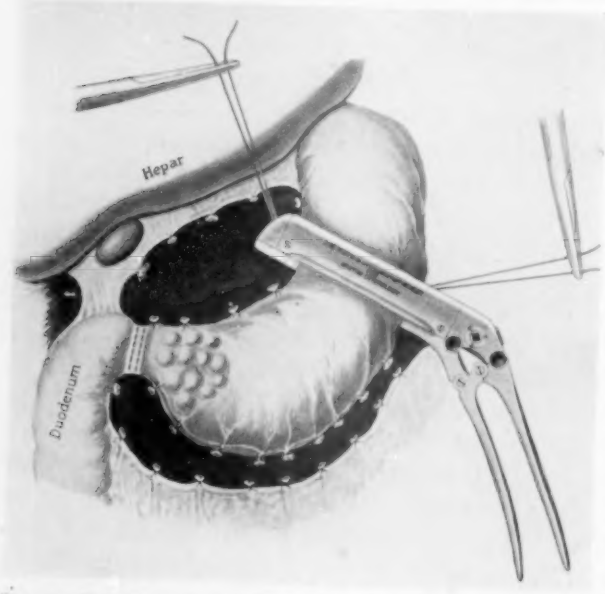

Fig. 1.—Resection of the stomach. First stage of Billroth II. retrocolica posterior.

Careful isolation of the area of operation, precise closing of stomach and intestinal wounds, and rapid and clean working are generally known and adopted measures while the details of the operating technic leave much to be desired.

The importance of the latter is best illustrated by the various and never ending experiments by means of which surgeons hope to solve the most difficult technical problems.

All sorts of instruments have already been designed to eliminate infection such as the stomach and intestinal clamps of Payr, Graser, etc., and various types of sewing apparatus including the one brought out by Hültl-Fischer which was probably the most serviceable and very likely the one most in use.

However, a great disadvantage of the Hültl-Fischer sewing apparatus is its high price, an item of special importance under existing economic conditions.

Therefore, we welcomed de Petz when he demonstrated his sewing apparatus on the occasion of the eighth annual meeting of the Hungarian Surgical Association in 1921, and recommended its use for the purposes of stomach and intestinal surgery. In vol. lxxxvi, No. 3, September, 1927, of the ANNALS OF SURGERY, de Petz explained his instrument and the operating technic connected therewith in detail, but as his instrument has not been hitherto universally adopted,* I think it worth while to state here a summary of our two years of experience.

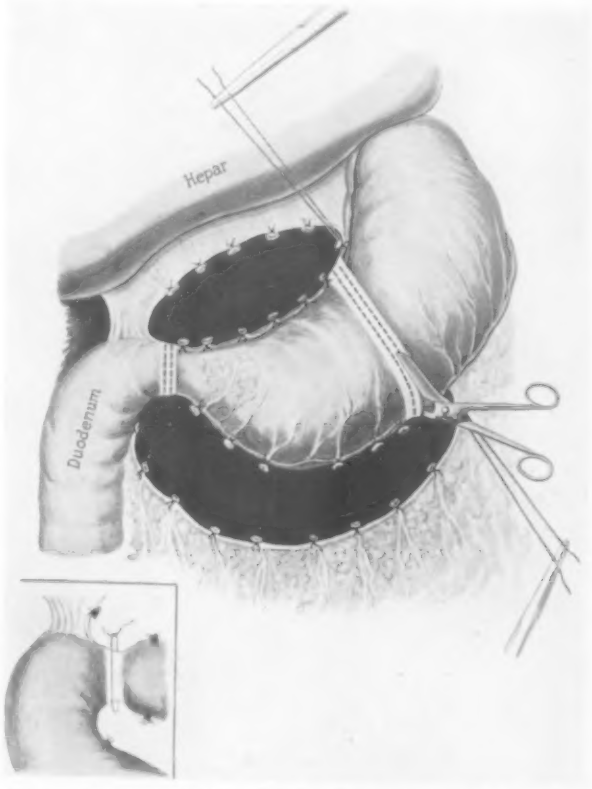

FIG. 2.—Resection of the stomach. Second stage of Billroth II, retrocolica posterior.

In literature I have found two references to the de Petz instrument, one dealing with successful operations by Klaus, of Tuttlingen, Germany, published in 1925 under the title "On the Technic of Stomach Resections" in No. 1 of the *Zentralblatt für Chirurgie* and reporting twelve cases of resection carried out by the author by means of the de Petz instrument, and the other reference having to do with Domenico Taddei, professor of surgery and director of the surgical clinic of the Royal University of Pisa, Italy, who, at the 34th congress of the Italian Surgical Association held at Padova in October, 1926, reported about his favorable experiences with the de Petz stomach sewing apparatus, the subject matter of his report bearing the caption "Per La Tecnica Delle Sezioni Gastrointestinali," published in the *Annali Italiani di Chirurgia,* Fasc. 12, 1926.

In the surgical clinic of Debreczen we have carried out 92 stomach resections during the last two years, 58 cases being resected by means of the de Petz sewing apparatus and, for comparison's sake, 34 cases without it, and our observations were chiefly centred on whether and in how many

* I am informed that about 100 of the de Petz sewing apparatus are at present in use in the principal countries of the globe. The Kny-Scheerer Company of New York are agents for it in the United States of America.

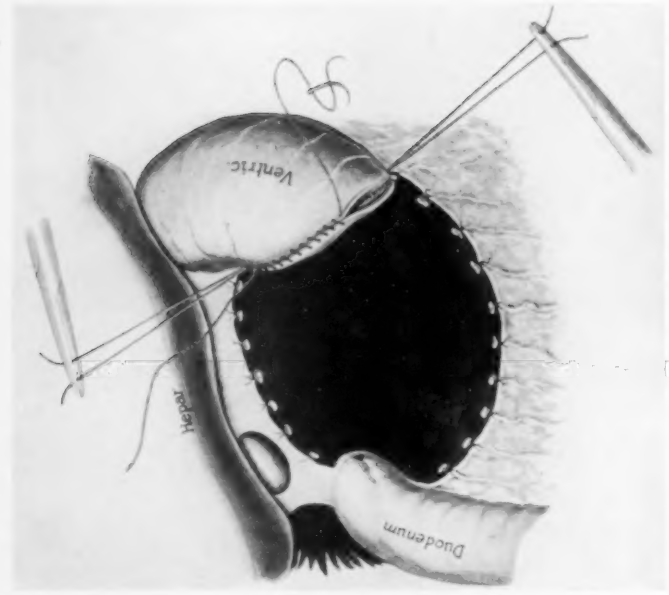

FIG. 4.—Resection of the stomach. Fourth stage of Billroth II, retrocolica posterior.

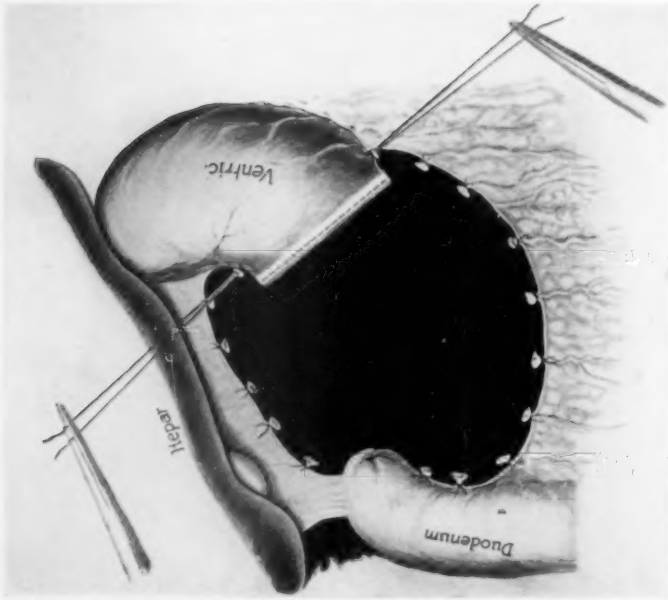

FIG. 3.—Resection of the stomach. Third stage of Billroth II, retrocolica posterior.

cases blood could be found after the operation in the expectoration of the patients. It was found that of the 58 cases treated by means of the de Petz instrument there were only 8 in which bloody expectoration could be noted after operation while in the 34 cases operated on according to the original hand-sewing method, we have observed in 7 cases larger quantities of blood in the post-operative expectoration of the patients.

Concerning the 58 cases of resection mentioned, the de Petz stomach and intestinal sewing apparatus was successfully employed in applying the provisional occluding suture in 10 cases of carcinoma of the stomach, in 17 cases of pyloric ulcer, in 30 cases of duodenal ulcer, and in one case of ulcus ventriculi tbc.

The passage was reëstablished in all cases by means of gastrojejunostomy, in 56 cases Billroth II retrocolica posterior and in 2 cases Billroth II oralis sec. Reichel-Polya being resorted to.

As the result of our ample and favorable experiences in above cases of resection, the use of the de Petz sewing instrument for the provisional occlusion of broad stomach and intestinal cavities became the rule in our clinic, and, in full agreement with de Petz, Klaus, and Taddei, I can summarize the main features of the instrument as follows: 1. Extremely simple to use. 2. Unlimited durability and unsurpassed simplicity. 3. Essential reduction of the operating time, which in gastro-intestinal operations is of utmost value. 4. Perfect asepsis. 5. The clip row is regular and waterproof. 6. The application of the sero-serous inturning suture of the stump is remarkably easy and simple. 7. The clips are naturally evacuated in the stool of the patient without causing any trouble. 8. By means of the instrument the resection of a carcinomatous stomach can be carried out much higher toward the cardia, *i.e.*, much more radically. 9. Filling of the instrument is very simple. 10. The hæmostatic effect of the clip row is very good and sufficient. It happens from time to time that in cutting through the furrow: one or two small arteries which have accidentally been situated between two clips have to be ligated, which, however, causes no trouble nor any danger nor any appreciable loss of time.

CARCINOMA OF THE OVARY IN INFANCY*

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and

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From the Division of Surgery of the Mayo Clinic

The case reported is of special interest because the patient is younger than any with carcinoma of the ovary that we have noted in the literature.

Report of Case.—The patient was a baby girl aged seventeen months. She had appeared normal at birth and had been well until six weeks previous to examination at the Mayo Clinic, when pertussis had developed. One month before there had been a slight blood-tinged vaginal discharge resembling menstrual flow. This lasted for only a few days but reappeared three days previous to examination. The mother had noted also that the breasts were unusually large and that there was an excessive amount of pubic hair. There had been moderate loss of weight. Two weeks before a mass had been felt in the abdomen, which was enlarging rapidly and had already reached the level of the umbilicus.

The child was about normal size for her age but her development corresponded to that at puberty. The breasts and external genitalia were overdeveloped. There was a fine growth of hair in the axillæ and on the labia, and a rather heavy growth of coarser, slightly pigmented hair over the mons veneris. A slight blood-tinged vaginal discharge was present. There was no evidence of mental precocity. A large, smooth, freely movable mass occupied the middle of the abdomen. The urine was normal; the leucocytes numbered 16,700 and the differential count was normal. Abdominal tumor, probably of ovarian origin, was diagnosed and exploration was advised.

The abdomen was opened through a long right rectus incision. There was about 1500 c.c. of ascitic fluid in the peritoneal cavity, and a large, firm, well-encapsulated tumor of the right ovary. There was no evidence of metastasis and the left ovary and the uterus appeared normal. The tumor and the right Fallopian tube were removed. Convalescence was uneventful and the baby was dismissed from the hospital on the tenth day. At that time the size of the breasts had decreased slightly.

The tumor weighed 1000 gm.; it was oval, measured 11 by 15 cm., and was surrounded by a smooth, grayish-white capsule which was not invaded by it at any point. The tumor was composed of moderately firm, grayish-white tissue, with multiple, small, smooth-walled cysts scattered throughout (Fig. 1). Microscopically two types of structure were present; a solid type predominated (Fig. 2) in which the cells had no uniform arrangement. The individual cells were moderately large, polyhedral, and had large, dark-staining nuclei. Mitotic figures could be seen in nearly every field. In a few areas there was glandular arrangement with papillary ingrowths (Fig. 3). Carcinoma of the ovary associated with multiple cysts was diagnosed.

Comment.—Masson and Ochsenhirt have recently reviewed 564 cases of malignant tumor of the ovary treated surgically in the Mayo Clinic from 1916 to 1926, inclusive. In this series there were five patients aged less than twenty years; the youngest was eight, two were fifteen, one sixteen, and one seventeen. All of the tumors were carcinomatous.

* Submitted for publication September 24, 1927.

Wiel, in 1905, noted in the literature twenty-four cases of ovarian tumor in children aged less than five years. There were seven cases each of simple cyst, dermoid cyst, and sarcoma, and one case each of teratoma, cystadenoma, and papillary cyst. Downes, in 1921, noted twenty-six additional cases of ovarian tumor in children aged less than ten years. Two of these were simple cysts, eight were dermoid cysts, and sixteen were malignant tumors.

FIG. 1.—Cross-section of ovarian tumor removed from an infant aged seventeen months.

In these two series the benign and malignant tumors occurred with about equal frequency.

Simple cysts of the ovary have been found in very young infants in a number of instances; Wiel noted two cases in the literature of infants of three and four months, and Downes, one at seven months. In the infants of four and seven months the symptoms had been present since birth. Sarcoma has been noted relatively often in the very young; by Doran in a seven months' fetus, by Downes and Knox, and by Harris in infants of twenty-two months, and by Hoffman in an infant of thirty-three months. Dermoid cysts noted in early infancy are usually small and slow growing and produce few symptoms before puberty. Carcinoma of the ovary is extremely rare in patients aged less than five years. We have not been able to find a case recorded in which carcinoma occurred earlier than in the case we have reported; although Downes and others have reported cases in which carcinoma of the ovary occurred at five years.

Symptoms and Diagnosis.—The symptoms of carcinoma of the ovary in children and infants are general and special. The general symptoms consist of the presence of an abdominal tumor which usually increases in size rapidly and is often discovered accidentally. It occupies the abdominal rather than the pelvic cavity because in children the uterus and adnexa are abdominal and not pelvic organs. For this reason, Downes has pointed out that symptoms from pressure on the bladder and rectum are seldom present. There is usually accompanying loss of weight. Pain is associated only with torsion, with intestinal obstruction, or with enlargement of the tumor. Anemia, diarrhœa or constipation, emaciation and symptoms arising from metastatic growths, are late occurrences.

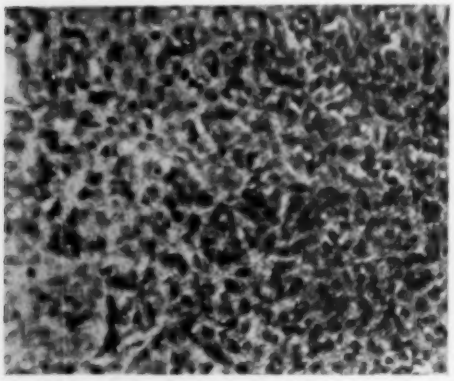

FIG. 2.—Solid arrangement of cells which predominated in the ovarian carcinoma. (x 120.)

The special symptoms associated with ovarian carcinoma and with other types of ovarian tumor in children are those of pubertas præcox. This is true homosexual precocity; the breasts and external genitalia develop and changes in fat distribution occur over the body in a manner similar to that which is normal at puberty. Pubic, labial and axillary hair appears. Menstruation is initiated as at puberty. Mental precocity is not present in these cases, the mental age corresponding as a rule to the age of the child.

While sexual precocity has been observed with other conditions, and especially with tumors of the pineal gland and the suprarenal cortex, variations exit which usually suffice to make the differential diagnosis. With tumors of the pineal gland, according to Reuben and Manning, precocious sexual development may occur, but since these tumors have been observed in the male in almost every instance in which the diagnosis has been proved at necropsy, there is little chance of confusing them with ovarian tumors. Moreover, pineal tumors are associated sooner or later with the clinical signs and symptoms of cerebral tumor, and abdominal tumor is, of course, lacking.

With tumor and hyperplasia of the suprarenal cortex the sexual precocity is of the male type. If the patient is a male, the masculine characteristics are accentuated, if a female, the precocity is heterosexual in type and consists of hypertrichosis, enlargement of the clitoris and, often, change in voice; however, the early appearance of menstruation is not a feature.

It is doubtful whether sexual precocity occurs in association with pathologic changes in other glands of internal secretion. Leiner, Reuben and Manning, and others, who have investigated this problem deny it. Ovarian hyperfunction not associated with ovarian neoplasm may present the syn-

drome of pubertas præcox, but in these cases there is no associated loss of weight and no tumor can be palpated in the abdomen. Cases thought to be of this nature should be observed frequently and carefully to rule out ovarian neoplasm of slow growth.

While it is usually possible to make the diagnosis of ovarian tumor on the symptoms and clinical data, it is seldom possible to determine clinically the type of neoplasm. Simple cysts, dermoid cysts, teratomas, sarcomas, and carcinomas of the ovary have all been observed in association with pubertas præcox and there are no characteristic clinical data that enable one to make the differential diagnosis. Other conditions which may simulate ovarian tumors are renal neoplasm, mesenteric cyst, and abdominal ascites, and in those cases in which the ovarian tumor is not associated with sexual precocity it may be impossible to make the diagnosis.

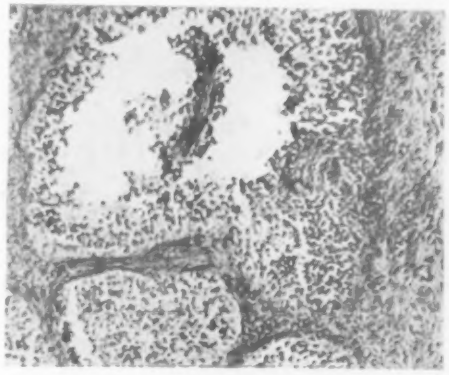

FIG. 3.—Glandular structure characteristic of portions of the ovarian carcinoma. (x 60.)

Treatment and Prognosis.—The treatment of ovarian tumors of any type, in infancy and childhood, is surgical. The only point on which a question arises is the advisability of removing the unaffected ovary. Until more cases have been reported with records of the ultimate outcome, it will be impossible to settle this question definitely. There is not enough evidence at present to justify the removal of an apparently normal ovary from a child in the presence of a malignant tumor in the other ovary. If the tumor is benign, the operation should, of course, be as conservative as possible.

These patients withstand operation well and following the removal of the tumor the symptoms of precocity usually subside rapidly. There is not sufficient data available on which to base an opinion in regard to the ultimate prognosis. In those few instances in which post-operative records have been available, the subsequent course has usually been favorable, depending of course on the duration and extent of the growth at the time of the operation, and especially on the degree of malignancy of the neoplasm.

The mechanism of the stimulus to the development of sexual precocity in these cases is not known. There are two plausible hypotheses in regard to this mechanism in the case of ovarian tumors: that the neoplastic growth acts as a non-specific stimulus to hyperactivity of the normal ovarian tissue, and that the neoplastic tissue itself functions. That the latter is not true in all cases, at least, is indicated by the occurrence of sexual precocity in association with simple cysts in which there is presumably no neoplastic ovarian tissue. We know, however, that neoplastic tissue in other organs is capable

of functioning to a limited extent, and that this occurs in inverse ratio to the degree of the malignancy. It is reasonable to conclude, therefore, that this may be true of ovarian tumors, especially those of carcinomatous type.

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ACID AND ALKALI BURNS OF THE EYE

AN EXPERIMENTAL STUDY

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The important chemical burns of the eye like those of the skin are mainly due to acid or alkali. It has generally been taught that the best method of treatment of such injuries is the use of some neutralizing agent, either alone,[1] or following irrigation of the eye with water.[2, 3] A year ago, Davidson[4] showed conclusively that the intensity of an acid or alkali burn of the skin is increased by use of a neutralizing agent and demonstrated that dilution is more effective than neutralization as a first aid method.

Fig. 1.—Showing a rabbit's eye forty-eight hours after a twenty-five-second exposure to 20 per cent. sulphuric acid. The acid was neutralized with sodium bicarbonate 2 per cent. Note the cloudy cornea.

The experiments on which this report is based follow closely the work of Davidson on chemical burns of the skin. The eye differs from the skin in presenting a continually moist surface. When an irritant is applied to the eye there is rapid outpouring of tears which tends to dilute and mechanically remove the offending material. Also the eye has no horny layer to protect it from injury.

In any attempt to save sight after a chemical burn, the cornea of the eye is the important area. Any opacity of this region causes loss of vision. The cornea is made up of several transparent layers. On the outer surface is a layer of epithelium limited below by Bowman's capsule. Beneath this are stroma cells which are limited on the inner surface by Decemet's membrane. To cause an opacity of the cornea, the injury must penetrate through Bowman's capsule. If the injury penetrates entirely through the coats of the eye, collapse of the eye results. Therefore, the extent of the permanent damage in the eye resulting from a chemical burn is directly related to the depth of which the burn is allowed to penetrate. There are three things which control this: (1) The strength and character of the chemical. (2) The length of time before initial treatment. (3) The type of initial treatment.

There is considerable confusion in the literature about the best method of treatment. This fact and the fact that there has been no controlled work

done, made it seem desirable to study the effects of various treatments in the laboratory where conditions could be controlled. Rats and rabbits were anæsthetized and the irritant instilled into the eye. At a set time by stop watch the initial treatment was given. This treatment consisted of irrigation from a rubber syringe with water or other solutions. The eyes were observed at twelve hours and every day for at least two weeks. Some of the eyes were examined microscopically. Control eyes without treatment were also observed. The time before treatment was varied to determine the length of time a given chemical could be left in the eye without causing a permanent opacity of the cornea after various treatments. It must be borne in mind that the rat's eye differs from the human eye, not only in thickness of the cornea, but in having a smaller amount of tears. So that the severe results noted in the rat would not be seen in the human. A drop of a chemical in the human eye would within a second be diluted at least ten times by the tears. Also the human eye is larger and a drop would not necessarily strike the cornea and interfere with vision before it had been diluted. The time increment, therefore, must be considered as only relative for clinical purposes.

FIG. 2.—Showing a rabbit's eye forty-eight hours after a twenty-five-second exposure to 20 per cent. sulphuric acid. The eye was treated with vigorous washing with water. The cornea is clear. Compare with Fig. 1.

As the rat's eye does not reproduce well, rabbits were used for the experiments of which photographs were taken.

Sulphuric Acid.—The action of concentrated solutions of sulphuric acid on the cell is the splitting off of the O and OH ions with resultant carbonization. Acid albumins are also formed.

FIG. 3.—Showing a rabbit's eye two weeks after exposure to 95 per cent. sulphuric acid. No treatment was given. The eyeball is completely destroyed.

Concentrated or 95 per cent. sulphuric acid in the eye without treatment completely destroyed the eyeball. The rat died in forty-eight hours, the destruction having penetrated to the brain, carrying infection with it. When the acid was neutralized with 2 per cent. sodium bicarbonate after ten seconds of burn, a similar destruction occurred, death coming in two or three days. The eyes treated by vigorous washing with water after a similar length of time were not collapsed but resulted in very marked scarrings of the cornea. None of the rats died.

Using 50 per cent. sulphuric acid the control eye showed very marked scarring of the cornea. Seven out of eight eyes treated with sodium bicarbonate in 10 to 15 seconds were similarly scarred. Of the eight eyes irrigated with water, seven had normal eyes in two or three days, one only showing some opacity of the cornea. Using 30, 20 and 10 per cent. solutions similar results were obtained.

A graph was made of the relative time a solution can be left in a rat's eye with the two treatments before causing a permanent opacity. This shows that the period of safety is lengthened 10 to 25 seconds by water treatment. These added seconds give us a greater possibility of saving sight. It further shows that at any length of time after a burn, water is better than neutralization, of course, excepting a period of burn sufficient to cause complete destruction, after which neither treatment is of any benefit in saving sight.

FIG. 4.—Showing a rabbit's eye two weeks after exposure to 95 per cent. sulphuric acid for ten seconds. The eye was treated with sodium bicarbonate. Note the partially degenerated eyeball.

Nitric Acid.—The action of nitric acid on the cell is, according to Sollman, a withdrawal of water, union with the cell compound to form acid albuminates and softening of the epithelium and connective tissue. A characteristic xanthoproteic reaction takes place. The removal of nitric acid before serious damage has been done is more difficult than sulphuric acid. Using 68 per cent. nitric acid the untreated and the eyes treated with 2 per cent. sodium bicarbonate all were completely destroyed. The eyes treated with water irrigations showed marked scarring of the cornea, but none were destroyed. After a burn of 15 seconds or longer, the eyes were destroyed despite the treatment.

FIG. 5.—Showing a rabbit's eye two weeks after ten seconds exposure to 95 per cent. sulphuric acid. The eye was treated with vigorous irrigation with water. The cornea is cloudy. Compare with figures 3 and 4.

Using a 30 per cent. solution, 100 per cent. of the eyes neutralized were completely degenerated, but only 40 per cent. of the eyes washed were lost. The remaining 60 per cent. of eyes treated with water resulted in permanent scarring of the cornea.

With 20 per cent. nitric acid, the control rats showed very marked scarring of the cornea. After a burn of from 5 to 20 seconds, 60 per cent. of the eyes treated with either water or sodium bicarbonate solution resulted in transparent corneas. However, the water-treated eyes cleared up two to three days before those in which sodium bicarbonate was used. The eyes irrigated with water showed some slight permanent opacity.

Ten per cent. nitric acid can remain in a rat's eye, 5 minutes, and result in a clear cornea if treated with water irrigation. If the acid is neutralized after a similar time, a permanent opacity results.

The question was raised—"Is neutralization better than washing alone, if it is

followed by or follows irrigation"? Eight eyes were neutralized first and then washed. The results in these were better than with neutralization alone, but none equalled the end results without preliminary neutralization. The same was repeated with neutralization after the irrigation. The results were practically the same as washing alone, which makes it seem that neutralization is not of added benefit, after good irrigation.

FIG. 6.—Showing a rabbit's eye two weeks after a ten-second exposure to sodium hydroxide 40 per cent. The alkali was neutralized with acetic acid 2 per cent. Note collapse of eye and contraction of lids.

Phenol.—The problem here is somewhat different than in the two preceding groups. Although commonly spoken of as an acid, carbolic is only very slightly acid to litmus. It is, however, a protoplasmic poison. It precipitates the cell proteins loosely, allowing the poison to penetrate deeply, causing death of the cells. Wells states that phenol may cause necrosis even in dilute solutions, due to the formation of hyalin thrombi of agglutinated red blood corpuscles. The question is not one between neutralization and irrigation, but between various irrigating solutions. Water, alcohol 20 per cent., sodium sulphate and glycerine solutions, were used as treatments. As carbolic is not soluble in water in suitable strengths, the fractional solutions used to produce a burn were dissolved in glycerine.

Using 87 per cent, carbolic, the untreated eye was completely destroyed. Eyes treated immediately after the burn resulted in clear corneas when water or sodium sulphate 4 per cent. were used. Using alcohol 25 per cent., the cornea showed some slight permanent opacity. When the acid was left 10 seconds or longer before treatment, 60 per cent. of the eyes treated with water resulted in transparent corneas, only 25 per cent. after alcohol irrigation and 10 per cent. after sodium sulphate treatment.

A 50 per cent. solution of carbolic in glycerine left in the eye without treatment, caused a very opaque cornea as an end result. After a burn of 10 seconds or longer, 30 per cent. of the eyes treated with any treatment had transparent corneas in three to five days. The treatments used were water, alcohol, sodium sulphate and glycerine. Twenty and 10 per cent. solutions gave similar results.

FIG. 7.—Showing a rabbit's eye two weeks after ten seconds exposure to 40 per cent. sodium hydroxide. The eye was treated with vigorous washing with water. Note the cloudy cornea. Compare with Fig. 6.

From the fact that water is as good or better than alcohol or glycerine, the solvents of carbolic, we feel that dilution does not play the important part in stopping the damaging effects of the chemical.

Sodium Hydroxide.—The caustic alkali in strong solutions combine with the cell albumin and fats to form alkaline albuminates and soaps. Due to the marked avidity

for water, the alkali penetrates deeply under the epithelium, causing necrosis. Davidson found in the skin a latent period before cell life was destroyed. We did not find any latent period in the eye. This difference is due to the lack of a protecting horny layer. The action is rapid on the unprotected cell as found in the cornea. The rapidity of action makes it difficult to obtain an eye useful for vision with any treatment.

Using a 40 per cent. solution both the control and the eyes neutralized with acetic acid, 2 per cent., were completely degenerated, with death of the rat in two to three days. The rats which were treated with water resulted in cloudy cornea in 50 per cent. of the cases, and complete degeneration in the remainder. No rats died. In the weaker solu-

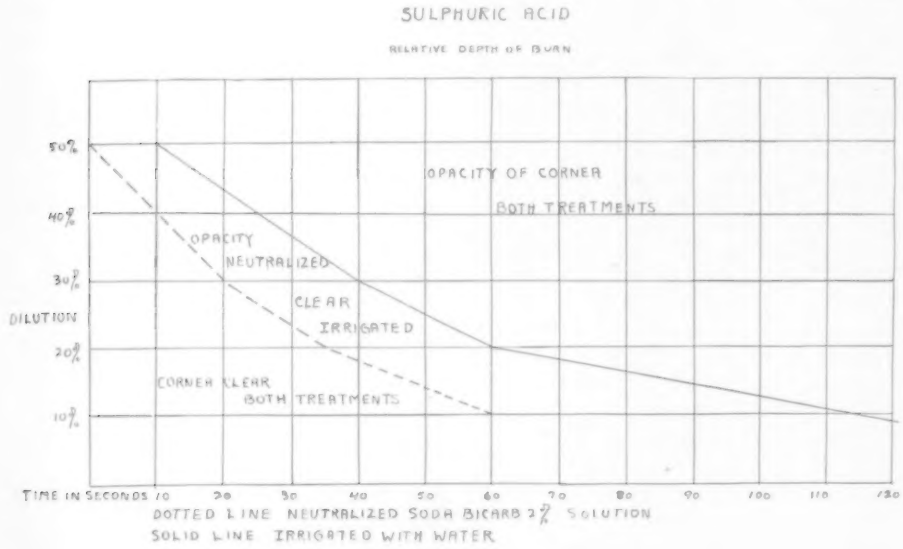

Fig. 8.

tions similar results were obtained, none of the eyes neutralized were saved and only about 50 per cent. of the eyes washed would be useful.

Ammonium Hydroxide.—The action of ammonia according to Sollman[6] is a penetration through the outer layers of the epithelium to form fluid in the lower layers with death of the cells. A 28 per cent. solution was used in the laboratory to produce burns. Acetic acid 2 per cent. and water were used as treatment. The cornea was destroyed when no treatment was given. When the alkali was neutralized with acetic acid 2 per cent., even after one minute of burn, a cloudy cornea resulted. However, when the eyes were irrigated with water any burn up to four minutes' duration resulted in transparent cornea. After five minutes sufficient damage had already been caused to result in permanent scarring.

DISCUSSION

It has been demonstrated by the experiments that neutralization of the caustic acids and alkalies cause increased damage to the cornea. This added damage may be the result of heat produced locally by the chemical reaction. Also there is the theory that water supplies the hygroscopic caustics with the necessary H. and O.H. ions, thus preventing their withdrawal from the cell. Free O. and O.H. ions in the cell are incompatible with cell life.

CONCLUSIONS

(1) It was found that, regardless of the concentration of a chemical or of the time interval, the best result is obtained with irrigation and that neutralization definitely causes damage.

(2) Experiments show that neutralization is not of added benefit after thorough irrigation and causes more damage when done before washing than washing alone.

(3) The mechanical removal of the chemical is the most important factor. This is shown in the experiments with carbolic which substance is not soluble in water.

(4) The tremendous importance of time before first aid is given has been demonstrated.

(5) It has been further shown that after a certain time of exposure for any concentration irreparable damage has been done.

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INDELIBLE INK-PENCIL INJURIES

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Subsequent to the widespread introduction into commerce of aniline and its dyestuff derivatives, a new and interesting chapter in medicine had to be written on both the harmful as well as the beneficial effects of these chemicals. On the one hand, there has come to recognition a knowledge of the baneful effects of aniline in the production of vesical papillomata and of the various forms of dermatitis, while on the other hand, there has developed a large traffic in drugs of aniline derivation for either oral or intravenous administration. Much has been written on the use of the relatively weak concentrations of this type of chemical agent, though but little has been said of the dangers incident to the exhibition of the more concentrated solutions.

The injury due to particles of indelible pencils is of this category. Because of its relative infrequence, practically no attention has been paid to the condition in this country, although it has received rather exhaustive consideration in the German literature. For a long time before its recognition by the surgeons, German ophthalmologists were all too well acquainted with the terrible effects resulting from the accidental injection of indelible ink particles into the conjunctival sac of school children. As a consequence of their agitation, the use of such pencils was prohibited in the schools. Indelible pencils are now used almost exclusively by clerks, who, therefore form the large bulk of patients suffering from injuries caused by the accidental implantation into hand or finger of a piece of the lead. Though uncommon, the injury, in this respect, may be almost considered as an occupational disease with the hands or fingers as the sites of selective involvement. In 1914, during the treatment of a patient who had stuck his finger with an indelible pencil, Erdheim was stimulated to a study of this condition. In the few cases which have since been noted in the literature, practically no additions have been made to the observations and conclusions originally reported by Erdheim in 1914 and subsequently in a more extensive communication in 1919.[1, 2] The writer, therefore, asks for indulgence if the report of a single case be made the occasion for calling the attention of the profession in this country to this interesting and unusual condition and for reviewing briefly the state of our knowledge on this subject.

S. W., a clerk, aged twenty-seven, was first seen in the spring of 1924, three days after having punctured the left index finger with an indelible ink-pencil. During the first two days the patient paid no attention to the injury, but on the third day noticed a slight rise in temperature, headache and a general feeling of malaise. On the following day he presented himself for treatment. The ball of the terminal phalanx of the left index finger was moderately swollen. At its centre was a small punctured wound, with a purplish discoloration from which a moderate amount of thin purplish serous dis-

charge issued. In the depths could still be felt the fragment of the indelible pencil. The patient complained of surprisingly little pain on pressure about the wound. The epitrochlear gland on the left side was palpable and enlarged. There was a slight increase in temperature. The patient still complained of a feeling of malaise but was not acutely ill. No attempt was made to remove the fragment of pencil, but the patient was advised to have the whole area excised. This he refused and the more conservative treatment by finger baths and wet dressings had to be instituted. Unfortunately, no X-ray photograph of the finger was made either at this time or subsequently. After the lapse of about six weeks under this form of conservative therapy, a large core of necrotic tissue separated and the wound soon began to heal. At the end of about eight weeks, the wound had completely healed, leaving a deep depressed scar adherent to the bone. There was, at no time, any evidence clinically of bacterial infection. There was no lymphangitis, œdema of the dorsum of the hand, nor any suggestion of tendon sheath infection. When discharged, the patient had complete use of the finger and when seen some six months later reported having had no trouble since the healing of the wound.

To even a casual observer the difference between the reaction caused by this type of foreign body and that occasioned by the more common types of foreign body must be apparent. In the latter case, the injuries are to be attributed either to mechanical insults such as fractures, the tearing of vessels and other structures or to the infection which develops secondarily in the presence of the foreign body. It is true that metallic substances, such as gold, platinum, silver, lead, etc., have been known to dissolve in the tissue juices and lead to greater or lesser symptoms of general toxæmia. The significance of lead in this respect has recently been emphasized by several authors, among them Habs,[4] who have confirmed Tuffier's original observation of lead poisoning developing from a bullet retained in a soldier's body. To this extent, these injuries may be compared with those caused by indelible pencils. But because of the relatively low solubility of such metallic substances, this complication must be looked upon as extremely unusual. Though the possibility of its occurrence must not be denied, it seems that no too great weight need be placed upon the report of sporadic cases. In the case of the aniline dyestuffs, however, the relatively high solubility of the chemical determines the rapid development of toxic symptoms. In fact, the whole clinical picture is so altered that the injury due to the presence of the foreign body *per se* becomes of secondary importance while the chemical necrosis assumes the primary rôle.

In studying the effects of indelible pencil injuries to the eye, Kuwahara [5] showed experimentally that graphite alone in the conjunctival sac evoked merely a foreign body reaction, while indelible pencil particles called forth exactly the same response as the aniline dye used in the manufacture of the pencils. From this the natural conclusion was drawn that the noxious agent was the soluble dye and not the inert graphite which acted as the carrier of the dye. Carrying the analysis somewhat further, Vogt [6] showed that aniline dyes could be divided into two main categories on the basis of their action on tissues. He showed that the acid and neutral dyes were almost without effect while the alkaline aniline dyes were extremely harmful to

tissue. When the basophilic nature of the cell nucleus is recalled, the mechanism of this reaction will be easily comprehensible as a direct chemical combination of the alkaline drug with the nuclear acids leading to the death of the cell. Of a series of different chemicals tested, it was found that those belonging to the triphenylmethane group, of which methyl violet is a member, were fraught with the greatest dangers to the existence of the cell. In a general way, this agreed with the results of Erdheim's experiments in which he showed that the aniline dyes increased in the degree of their tissue toxicity from those that were green, through yellow, red, brown up to the most noxious blue.

In cases examined as early as one hour after the injury, very little is seen beyond slight irritative reactions and a tendency to hemorrhage but no necrosis. In cases observed after the lapse of twenty-four hours, there is definite evidence of necrosis of surrounding tissues. As a result of his painstaking animal experiments, Erdheim was enabled to reconstruct the course of events initiated by the introduction subcutaneously of an aniline dye in the form of an indelible pencil, in the following manner. Immediately after the subcutaneous imbedding of the dyestuff, there is a rapid outpouring of tissue juices and a sort of pseudo-cyst is formed. At first this cyst is tensely filled, but as the dye dissolves, the fluid gradually diffuses into the surrounding tissue spaces. As time goes on, the cells which come in contact with this highly concentrated dye solution are stained and die. The further the dye diffuses into the tissues, the less its concentration until a point is finally reached where its potency is insufficient to cause cell death. Beyond this region which really determines the site of the line of demarcation, a protective barrier of leucocytes is established and still further beyond this a zone of granulation tissue. In a typical cross-section, therefore, there would be seen four well-defined concentric zones; a central cyst-like space in which the aniline foreign body lies, then a zone in which chemical necrosis of the tissues has taken place, next the region of the leucocytic wall and finally the reparative area of granulation tissue. The two innermost of these four zones are destructive in nature, and may involve tissue of any type, whether soft type or bone. Even in the case where the concentration of the dye is insufficient to lead to actual necrosis and subsequent sequestration of the bone of an involved finger, an undeniable osteoporosis due to chemical interference with the nutrition of the bone can be demonstrated on the X-ray photograph. The necrosis is completely aseptic and neither leucocytes nor bacteria are found in the area bathed by the lethal fluid. As a consequence, the definitive processes of repair are held in abeyance until the whole necrotic mass has been extruded after its separation at the line of demarcation.

Clinically, there are two types of reaction to the sort of chemical injury induced by indelible-ink pencils. In the type characterized by the appearance of only local symptoms, there is usually nothing more to be seen than a small punctured wound. The wound and the surrounding tissues are highly dis-

colored and from the mouth of the wound there issues a moderate amount of dye-stained serous fluid. There is no evidence of inflammatory reaction and beyond a slight feeling of discomfort, the patient seldom complains of pain. This is doubtless due to the fact that the nerve endings are involved in the same necrotic process as the other neighboring tissues, and secondly, to the fact that in the absence of inflammatory reactions, there is no increase in the tissue tension. Methyl violet seems to be most common in the production of this type of reaction. In the development of the general type of reaction, methyl blue appears to be even more potent. The patient presents the appearance described above, and in addition usually complains of headache, fatigue, slight rise in temperature, and general malaise. These latter symptoms can only be attributed to a general toxic effect resulting from absorption and distribution of the dye by the lymphatic system. Left untreated, the affection is extremely chronic and shows no tendency toward healing until the extrusion en masse of the necrotic tissues.

In cases treated shortly after injury, Glass [3] has shown that incision, curettage and lavage of the wound with a 1 per cent. solution of trypan flavin is frequently sufficient to result in healing. On the other hand, in cases treated at a relatively late stage, wide excision and even amputation is often necessary to bring about cure. The attempt to remove the offending particles of dyestuff through the small puncture hole by the use of a forceps is of all means the worst that can be employed. The result usually is that the foreign body is broken in many smaller fragments, the protective wall is injured and the tissue spaces opened for the wider and more rapid diffusion and absorption of the injurious solution. That a wound caused by an indelible pencil may heal under a strictly conservative form of treatment is shown by the case above reported. But, while this may occur occasionally, the risks involved far outweigh the benefits which may attend such a course. It is felt that the only rational form of therapy, the one which involves radical procedure with the purpose of conservation of tissue and function, lies in the wide excision of the wound and its contained foreign body at the earliest possible moment.

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CHROMOMA OF THE FOREARM

A STUDY OF AN UNUSUAL TUMOR

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In the current (June) number of *Surgical Clinics of North America* (page 243), Cornett reports an unusual ulcerative lesion of the forearm. The history was briefly this: Twenty months before admission the patient's arm was spiked in a ball game. The wound failed to heal but began gradually to increase in size. Repeated liberal biopsies were made and slides submitted to a number of pathologists of first rank who disagreed as to diagnosis. Not until after the death of the patient and the metastasis in the lymph-glands were examined was a general agreement to a diagnosis of carcinoma reached. To this diagnosis Dr. James Ewing agreed but added that the cells "are quite anaplastic and therefore lack some of the squamous-celled characteristics." Let us not lose sight of these words.

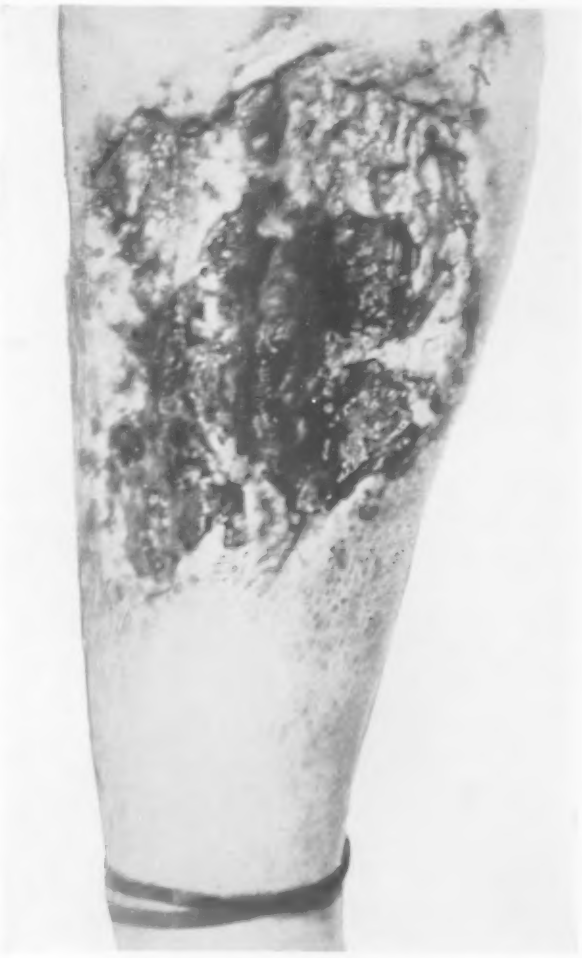


Fig. 1.—Large ulcerous tumor of the forearm.

I have been struggling with this type of tumor for more than twenty years and the paper above quoted emboldens me to report several cases which involved the arm and presented many of the characteristic features of the patient reported by Cornell.

In my paper on "Melanoblastomas of the Foot" (Annals of Surgery,

vol. lx, p. 88, 1914), I described several cases running a similar course. They began for the most part as nodules beneath the skin and by their growth destroyed the skin. These nodules extended gradually peripheralwards, destroying the skin always by developing beneath it, but never stimulating the epithelium of the skin to participation. In a number of cases protuberant tumors were produced. These tumors grew slowly, always spread by way of the lymphatics, and in the more rapidly growing areas the cells predominated and produced alveolar-like arrangements (see Fig. 15 in the paper above quoted). The metastases also not infrequently showed alveolar arrangement. They were influenced not in the least in their course, not even by amputation in cases where the growth was small and apparently of recent origin. This paper had to do only with the tumors of the foot. In these tumors of the foot the close association with pigment caused me to give them the name melanoblastoma with the sub-title of chromatophoroma. These tumors of the arm which ran a course similar to my foot tumors, I believe are parallel, likely identical with the case reported by Cornett above mentioned. The case reports follow.

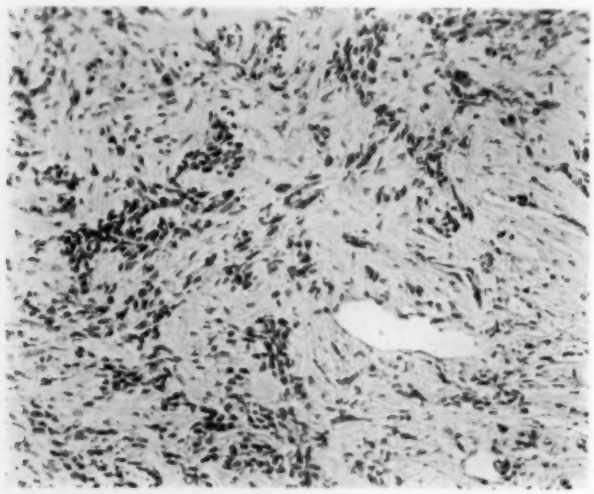


FIG. 2.—Slide from the nodules shown in the preceding picture.

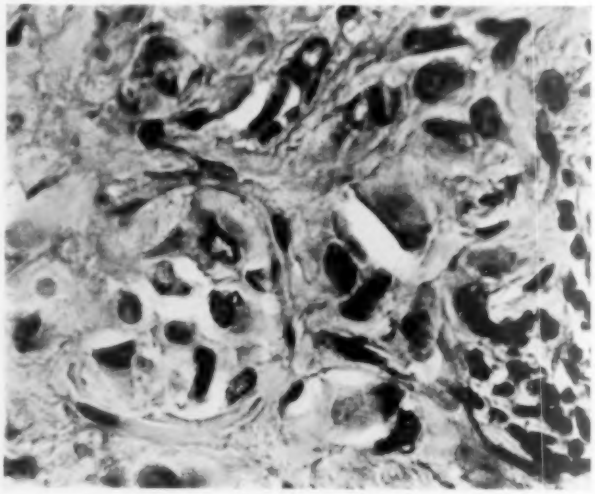


FIG. 3.—High power of the preceding showing large cells so arranged as to suggest nest formation.

CASE I.—Male, age thirty. Railway mail clerk. Two years ago he noticed a painless, round, firm tumor on the inner surface of his forearm. He had received a contusion in a railway accident some time previously. This tumor was removed but the wound did not heal and later a new tumor protruded from the wound. Now followed a long series of treatments.

Various local applications were used. Mercury and salvarsan were given in maximum doses. X-rays and radium were used persistently, but the ulcer grew.

When I first saw him an ulcer the size of the palm of his hand occupied the radial side of the forearm (Fig. 1). The outline was irregularly spheroid. The borders were somewhat overhanging and infiltrated. The body of the ulcer was lined by coarse granular elevations of a deep red color. They did not bleed on slight touch, but bled when the dressing was removed. The process from start to finish was entirely painless. With treatment the ulcer gradually deepened until the radius and ulna were exposed in the body of the wound. Still there was no pain.

FIG. 4.—The tumor protrudes from the depth, destroying the skin.

Histology.—Underneath the skin near the border of the ulcer were a group of spheroid cells, irregularly arranged. The proportion of cells to connective tissue varied much in different parts of the field. The vessel walls for the most part were thin with relatively thick endothelial lining. Nowhere was there contact between these cells and the epidermis. The cells were small, containing a relatively large deeply staining nuclei (Fig. 2). This picture suggests Fig. 159 in Cornett's paper as far as I can make out. The general appearance was that of a chronic reactive process. On closer study where the cells are not so closely packed, one can make out that the cell contains a considerable protoplasm which does not fit in so well with the hypothesis of a reactive process (Fig. 3). All attempts to discover an organism were futile.

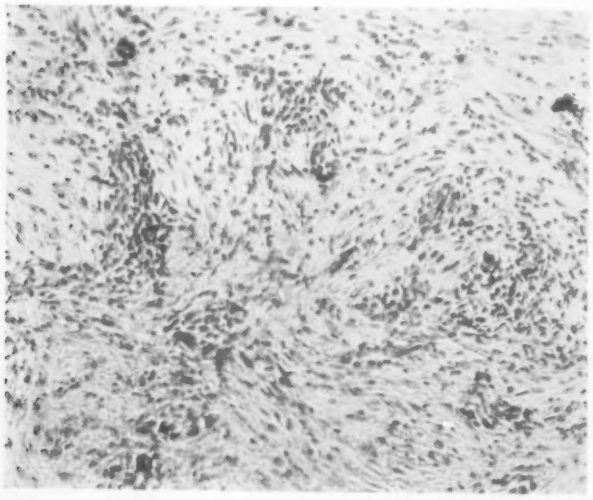


FIG. 5.—Low power of the tumor shown in the preceding figure.

CASE II.—Male, thirty-two years of age. Accountant. Two months before he consulted his physician he noticed a tumor one-half the size of an egg three inches above the elbow. There was no pain nor impairment of function.

The tumor was excised. Healing was slow and a tumor mass three times the original mass filled the excavation. Two months later the tumor was again removed. It was

separated with difficulty from tendons and nerves. Radium was used following the operation.

Four months after the second operation I saw the patient and obtained a photograph of the tumor (Fig. 4). An irregular bossilated mass protrudes from the wound. The nodulations are dense, elastic, do not bleed as readily as a carcinoma on manipulation and are quite insensitive to touch. The skin border is thickened, but macroscopically and on section is shown to be quite free from the growth beneath.

Histology.—As in the preceding case the masses of cells about the skin border are free from the epidermis. At the most advanced border the groups of cells were small and were directed radiatingly downward toward the deeper tissue but showed nowhere any derivation from the epidermis. In some areas the cells are diffuse, in others they are arranged in groups showing an indefinite nest formation. The cells are characterized by large deeply staining nuclei with a considerable amount of protoplasm. This slide suggests the appearance of Cornett's Fig. 160. Even in this slide there are areas that suggest group arrangement (Figs. 5 and 6).

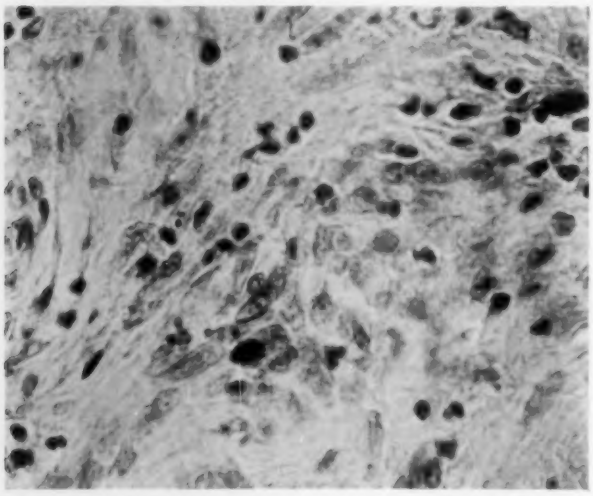


FIG. 6.—High power of the preceding showing the large cells like those in Fig. 3.

CASE III.—Female, age thirty-five. Two years before consulting her physician she noticed a painless lump the size of a hickory nut just beneath the skin of the forearm. It was quite painless. The tumor was removed but the wound never healed. The tissue was sent to this laboratory for examination. A diagnosis of a chronic reactive process was made.

The wound having failed to heal, the patient appeared in person. The tumor now appeared as in the photo (Fig. 7). The affected area was widely excised.

Histology.—The picture is as in the preceding: groups of cells free from the skin and invading the surrounding connective tissue. Smaller cells with deeply staining nuclei dominate the field, but here and there larger cells with granular nuclei may be seen (Fig. 8). It appears that it is these cells that travel to the neighboring lymph-glands.

SUMMARY

These tumors of the arm begin as nodules beneath the skin and apparently free from it. They gradually destroy the skin and continue to spread. The skin is destroyed by them as they advance but they are at no time associated with the skin. The ulceration continues to destroy the surrounding soft parts, in one of my cases exposing both bones of the forearm. They are never painful.

Histologically they begin as irregularly distributed cells beneath the skin forming more or less horizontal lines to the skin. In the various parts of the tumor the degree of fibrous tissue formation varies. Everywhere there is the same cellular arrangement. When the smaller cells dominate the process

may be mistaken for a reactive one. In the older tumors the larger type predominate. They always metastasize by way of the lymphatics. In the more rapidly growing tumors a cell nest arrangement is common, but in the very slowly growing ones the lymph-glands may be almost entirely fibrous. By slowly growing I would include those in which the gland has been enlarged for some three to seven years.

Discussion.—My hypothesis is that these tumors are derived from the chromatophore cells. In the earliest part of the tumor the cells are arranged like the chromatophore cells and they look like chromatophore cells.

These arm tumors are free from pigment. This does not mitigate against their being chromatophores. In the foot sometimes they do bear pigment. Recent researches seem to have absolved the chromatophores from the manufacture of pigment and ascribe to them the function of absorbing pigment.

FIG. 7.—Early recurrence in Case III showing the old scar with the early appearance of an ulcer.

When one tries to decide the purpose of the chromatophores one is struck by the fact that they are found chiefly about blood-vessels. In teased specimens they resemble very closely the clasmatocytes of Ranvier. From studies in wound healing I am disposed to conclude that their chief purpose is to aid in repair, particularly to form new vessels. I suspect they may aid in the repair of epithelial surfaces and that their function, in other words, is chiefly a reparative one.

I believe an extended study will convince anyone that the tumors in question are derived from these cells. Tumors derived from them are slowly growing, fibrous tissue producing tumors, often of exceedingly slow growth.

It is only when they do grow rapidly that the cellular elements predominate and alveolar arrangements are seen. In melanomas frequently the metastatic nodules form a distinct alveolar arrangement while the parent tumor is of a different structure. These are much more rapidly growing tumors.

These tumors in question differ from melanomas in their clinical aspects. They are more destructive locally, are more slowly growing and metastases are not formed so extensively and never metastasize by way of blood stream.

It is confusing that the name chromatophores should have been applied to these cells. It is merely expressive of a former theory as to their nature. Studied in wound healing they suggest very much the clasmatocytes of Ranvier as one sees them in reactive processes of the peritoneum. They likely are as ready to pick up anything (lampblack, vermillion) as chromatin. Since we have this word it would seem to lessen the evil by calling these tumors chromatomas. So long as we remember that they have only a very remote association with chromatin the word serves very well. When one studies these tumors in the foot one sees that the pigment in the primary tumors is lost in the metastasis, even in the more cellular. In my previous paper (following Ribbert) I was wrong in ascribing a close association with melanomas. It is possible that the melanin in pigmented warts may start off the chromatophores, but once started they manifest their own characteristics as is manifest by their course.

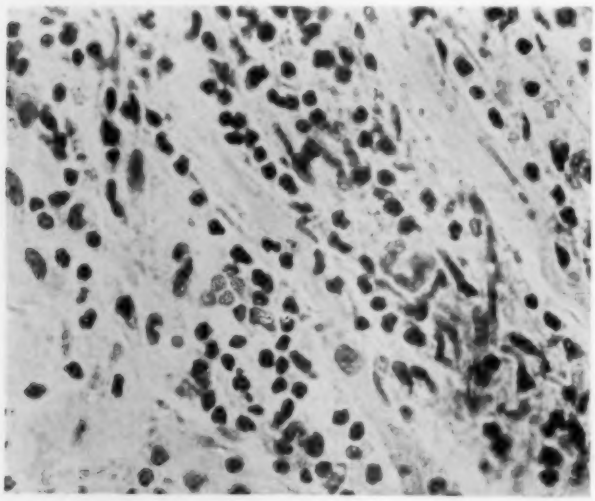


FIG. 8.—High power photograph of a slide from the ulcer area.

The older among the readers will remember what a neat little plastic operation in philology Waldeyer performed when he changed the cumbersome word neurondendron into the simple "neuron". If an equally weighty personage will perform a like operation on the cumbersome chromatophoroma and make it simply chroma, we will have a convenient word not too lacking in euphony. Of course it will be meaningless, if not altogether misleading, but since students no longer learn Greek, that fact is not likely to cause pain or confusion.

Conclusions.—Chromatophores are capable of producing a slowly growing tumor or ulcer that is characterized by slow growth, metastasizing by way of the lymphatics and proceeding relentlessly to a fatal issue.

That they at no time are associated with epithelial elements though they resemble very much anaplastic epithelial cells.

FORMATION OF RADIUS CONGENITALLY ABSENT*

CONDITION SEVEN YEARS AFTER IMPLANTATION OF BONE GRAFT

By Fred H. Albee, M.D.
of New York, N. Y.

In all bone-grafting operations, adequate function and prevention or correction of deformity are the prime desire of both surgeon and patient. The late end results are particularly interesting in these cases, because they illustrate so graphically the remarkable ability of the autogenous graft to strengthen with use and stress, and to act as a corrective agent.

Fig. 1.—Congenital absence of radius. Note bowing because of absence of radii; also absence of thumbs.

Recently, while attending the meeting of the American Orthopedic Association in California, it was my good fortune to meet a patient who had come to me seven years ago, at the age of twelve, with congenital absence of both radii, and both thumbs. At that time the ulnæ were markedly bowed, and the hands turned inward (Figs. 1 and 2). A graft was taken from the tibia and its wedge-shaped ends mortised into properly prepared orifices in the right carpus below and the shaft of the ulna above (Fig. 3). A similar operation was later performed on the left arm. After the graft had thoroughly united with the carpus and ulna, an osteotomy was done on each ulna to correct the marked ulnar deviation (Fig. 4). It was advisable to produce over-correction as shown in the X-ray.

Recovery was uneventful and I had not seen the patient since four months after operation, when X-rays showed good union and considerable increase

* Submitted for publication September 27, 1927.

in the diameter of the graft (Fig. 5). At that time the patient could lift weights (Fig. 6) which was not possible before operation because the wrists were flail, owing to the absence of the radius, which is the important bone in the wrist-joint. When the radius is absent, the hand pivots without control on the end of the ulna.

When I met the patient this summer in California, she had just come in from a tennis tournament in which she was one of the semi-finalists. A

FIG. 2.—Pre-operative X-ray.

junior at college, she drives her own car, rides horseback, and devotes much of her leisure to painting. The ease with which she uses her arm, the degree of activity to which she submits it without fatigue, and the lack of awkwardness suggest a normal arm, and bear striking evidence to the possibilities of reconstruction surgery.

Figure 7 is an X-ray taken in June, 1927. Considerable correction of the bowing, which externally is not at all evident to the casual observer, and marked proliferation of the graft will be noted when compared with the earlier X-rays.

Congenital absence of the radius is rare. The author has seen ten cases and operated on three in the last ten years. Three cases are at present awaiting operation. The anomaly is reported as being more often unilateral than bilateral, and usually right-sided. In two of the author's operated cases, however, the condition was bilateral. In such cases it is advisable to operate on the right arm first.

If the child is very young when brought to the surgeon, it is advisable to wait until he is three years old before operating.

FIG. 3.—Post-operative X-ray, December, 1920, showing graft *in situ*.

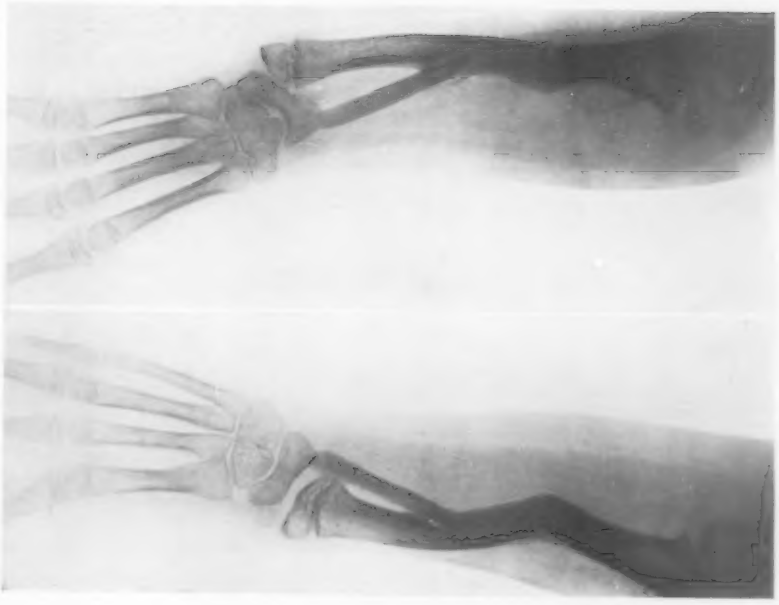


FIG. 4.—Post-operative X-rays, January, 1921. Note osteotomy to correct ulnar bowing.

The second bilateral case was brought to the author when the child was seven weeks old. There was marked bowing of both ulnæ (Fig. 8). In

FIG. 5.—Post-operative X-ray, several months later.

March, 1927, when the child was three years old, a tibial graft was placed in the right arm. After the case was removed a brace was applied, a wise precaution in very young children, to protect the graft until it becomes thoroughly strong. The union in this case is excellent. The child evidenced his pleasure when last he came to the office by presenting me with his teddy bear and asking me to "put a new radius bone in its arm."

FIG. 6.—Post-operative still. Patient able to lift weights, and uses pencil between fingers.

Although it is usually preferable to mortise the graft into the shaft of the ulna, the upper end of the graft may be placed between the muscle planes of the forearm in the region where the upper end of the radius should be situated. This was done in Case II.

In one case, because of congenital absence of the carpus, the graft was

Fig. 7.—Post-operative X-ray. Case I. July, 1927. Graft has proliferated, and bowing of ulna is corrected.

Fig. 8.—Congenital absence of radius with marked deformity in child of three. (Case II.)

Fig. 9.—X-ray of same case, three months after operation. Graft in place. Position of hand much improved.

mortised into the first metacarpal at the distal end. The proximal end was placed between the muscles on the radial side of the forearm instead of being mortised into the ulna. At the time of its insertion, the graft was under considerable lateral tension because of the marked tendency of the hand to seek an angular posture with the forearm toward the radial side.

As a theoretical consideration, at least, it would seem that placing the upper end of the graft between the muscle planes affords a certain advantage, as it will allow the graft to be pulled down slightly during growth, thus taking advantage of epiphyseal growth at both ends of the ulna, and minimizing distortion during growth, which occasionally occurs owing to the epiphysis at the carpus being pushed out. On the other hand, stability may be slightly jeopardized by this procedure, and because of this latter consideration it is not adopted routinely.

In one of our early cases, reported in the author's "Orthopedic and Reconstruction Surgery," the first graft was not mortised at either end, but merely placed between the muscle planes, with contact with the scaphoid at the distal end. This graft proved unsatisfactory because it did not afford sufficient mechanical support. A second graft was inserted five months later, and firmly mortised at each end by the author's inlay technic. This united firmly and afforded excellent support to the wrist. The X-rays taken six months after operation showed increase in strength and dimensions of the graft, as in the case now reported. (See Fig. 615, p. 905, "Orthopedic and Reconstruction Surgery.") The case was a brilliant success.

THE USE OF A FLEXED PLASTER SPICA CASE IN THE TREATMENT OF HIP FRACTURES

By George Albert Moore, M.D.
of Brockton, Mass.

A review of recent progress in the treatment of hip fractures shows that there has been a gradually increasing interest in this subject during the past twenty-five years. This has resulted in a clearer understanding of the underlying pathology of hip fractures and in the development of new and more efficient methods of treatment. There has also resulted a somewhat lower mortality and higher percentage of good functional end results.

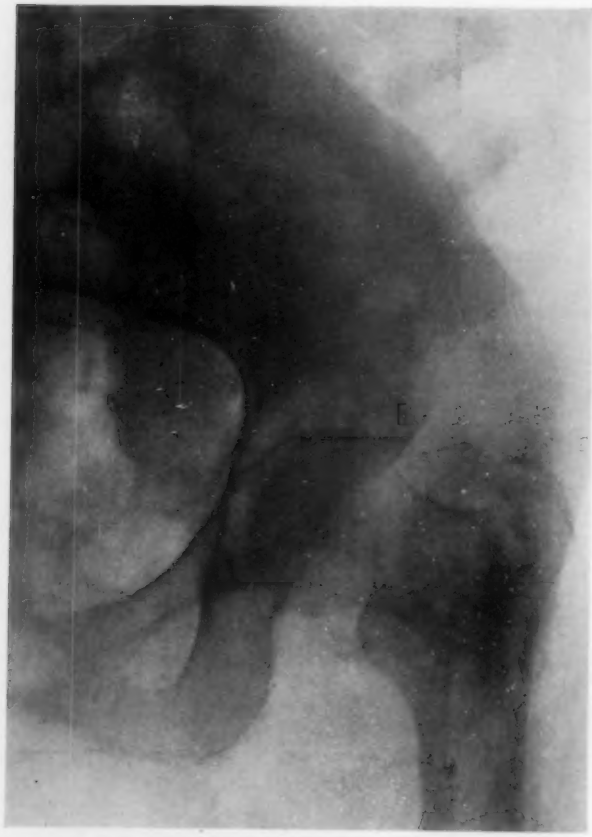
Fig. 1.—No. 1121. Anterior view of flexed spica case. Note inverted position of leg and foot.

These facts have been well brought out by Faltin [1] and Lindgren,[2] who published in 1924 an exhaustive compilation and summary of the literature on the subject.

Faltin reviewed the anatomy and pathology of the various types of lesions encountered in these fractures and discussed their various possible methods of treatment. He drew attention to the lack of recent investigation of the circulation of the hip-joint, and stated that the studies of Lang,[3] Delidoff [4] and Basset [5] each have shown conclusively that the blood supply to the neck of the femur is in two synovial folds which extend along the anterior surface of the neck. The nutrient arteries enter the neck at its narrowest part, near the middle, which on account of its structure and poor blood supply not only is a frequent site of fracture, but often

unites unsatisfactorily. Faltin also suggested that the absence of periosteum covering the neck of the femur and the resulting slow formation of callus which is endostial in origin in fractures in that region might be another factor in causing delay or lack of union.

According to Basset the blood supply to the head of the femur through the ligamentum teres is sufficient to prevent necrosis of the head after fracture, even in old people, and is a distinct aid in promoting bony union when suitable treatment is carried out.



FIGS. 1 and 2.—No. 1121. Röntgenogram after reduction. Bony union and excellent function resulted. Age seventy-six.

Faltin argued that the high mortality following hip fractures so often encountered was due in the majority of cases to complications arising from the protracted bed treatment used in conjunction with many modern methods of treatment.

Regarding the most satisfactory method of reduction of fractures of the femoral neck, there were still divergent views held by different writers. Lucas-Championniere,[6] Kocher,[7] Böhringer,[8] Anschutz[9] and others advised that impactions of the broken fragments should not be disturbed except in cases of marked deformity, as their presence appeared to have some beneficial effects in promoting union. Bardenheur,[10] Hoffa,[11] Whitman,[12] Maxwell,[13] Lorenz,[14] Nicolaysen,[15] Ruth,[16] Judet,[17] Waldenstrom [18] and Matti,[19] on the contrary, broke up and reduced nearly all fractures of the neck of the femur with satisfactory results. The value of Cotton's [20] plan of artificial impaction was difficult to estimate as Cotton combines his method with Whitman's abduction case.

Faltin favored as a general rule reduction of all fractures of the neck except in the very feeble and in those with slight deformity, since impactions were not necessarily permanent and might break loose later on, thus causing prolonged disability.

The so-called "bloodless methods of treatment" of hip fractures which result favorably were discussed impartially by Faltin. Lucas-Championniere advocated a method which consists in "massage, early mobilization and non-protracted stay in bed" in all cases of hip fractures. As a result of his system of treatment, he has his patients up and walking about in eight to fifteen days after injury. He has reported many excellent results, but has gained few adherents to the method he uses. Of the "traction" methods, those of Phillips, Maxwell and Ruth[21], Bardenheuer and Judet seemed most worthy of consideration. The general principles of these methods are similar, longitudinal traction on the injured leg and lateral traction on the hip to put the capsular ligaments on stretch, thus holding the fragments in apposition. Elaborate detail was required in their application and painstaking care necessitated throughout treatment. Excellent results have been reported, especially by Ruth and Bardenheuer. Whitman's abduction method of treatment had the disadvantages of a prolonged anæsthesia, reduction trauma, a heavy bandage and strong abduction position which prevented the patient from walking.

FIGS. 1 and 2.—No. 1121. Röntgenogram of hips before reduction.

The various splint and bandage methods of treatment all depended for their effectiveness upon the principles of the Thomas splint and all attempted to transfer the strain of weight bearing from the foot and leg to the tuberosity of the ischium. Some, as the Thomas long hip splint, Maseland[22] splint and Jones[23] abduction frame were intended for bed treatment, others were devised for ambulatory cases and combine abduction and traction of the injured leg. Of the latter methods, those of Bradford,[24] Borghi-Rossi,[25] Bender[26] and Haslauer,[27] which attempted to get the patients on their feet as soon as possible, seemed of real value.

Lindgren attempted to evaluate the end results of the treatment of hip fractures reported by several writers and treated by various methods and also

gave a detailed account of his investigations of 95 cases cared for at the surgical clinic in Upsala. He stated that the reports in the literature of the careful, painstaking study of the end results of the treatment of hip fractures were very scarce and gave this fact as one of the important reasons for the general slow adoption of active methods of treatment. For example, Ridlon [28] reported twenty good results out of thirty-five cases having no systematic form of treatment, in order to emphasize the belief that an undisturbed solidifying process during a sufficiently long period was one of the most fundamental factors in securing a proper union in fractures of the neck of the femur. Lindgren, however, believed that no general conclusions could be drawn from Ridlon's statistics as there was no classification of the fractures. Lindgren also questioned for various reasons the value of conclusions drawn from reports by Campbell,[29] Cotton,[30] Basset and Moore.[31]

FIG. 2.—No. 1121. Lateral view of flexed spica.

His own figures were compiled from 49 cases of medial fracture of the neck of the femur and 46 lateral fractures. Thirty-one were treated by conservative methods with a death rate of 26 per cent.; and 64 were treated by active methods with a death rate of 20 per cent. The so-called conservative methods employed were: 1. Bed confinement without fixation of the injured hip. 2. Apposition of the broken fragments and fixation with sand-bags. 3. Indirect extension with abduction under seven or eight kilograms. Of the medial fracture cases treated in this manner all but one resulted badly, the lateral fracture cases, however, obtained a high percentage of satisfactory results.

The active methods of treatment consisted in immediate direct extension of the impacted fragment with Schmerz tongs in a few cases and abduction methods in a large number of the series. In cases treated with the Schmerz tongs a half plaster case was applied at the end of three to five weeks. The abduction method consisted in reduction of the fracture under anæs-

thesia, the leg being then put in a half plaster-of-Paris case, from the nipple line to the malleoli with the knee in slight flexion. In a few cases a circular spica case was used. Results with Schmerz tongs were unsatisfactory, and much poorer than when the abduction method was used. Of 26 patients treated in abduction, 10 had true bony union. Of the thirty patients with lateral fractures, on the other hand, examined one year or more after treatment was begun, all had obtained bony union. Disability in these cases was due to faulty position of the fragments.

Lindgren concluded that cases of fracture of the neck of the femur have fairly good chances of union if the broken fragments are placed in perfect apposition and retained in this position during the period of callus formation. They should be allowed to become firmly united by proper protection from various mechanical strains during a long period of time. He considered that medial fractures were apt to be followed by defective union and were a most serious problem as regards treatment. Bony union could be obtained in a large percentage of cases, however, if utilization and encouragement of the healing propensities were practiced.

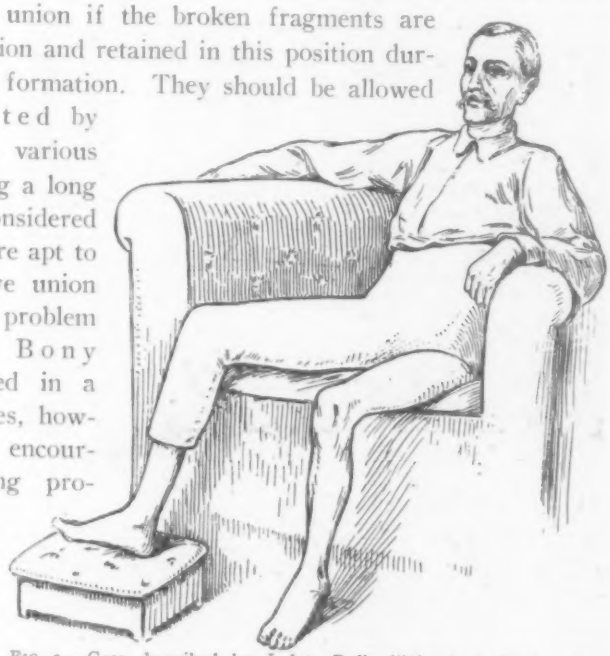


FIG. 3.—Case described by Judet: Bull. d'l'Acad. d. Med., 1921, vol. lxxxv, p. 63.

So discouraging have been the results of treatment of medial fractures in the past that many writers, notably Cooper,[32] Kocher, Anschutz, Delbet,[33] Robineau and Contremoulins,[34] Judet, Konig,[35] Bonn [36] and others have advised early operation in such cases with reduction and bone pegging or excision of the head and a reconstruction of the neck of the femur.

In recent years, a number of writers such as Cotton, Ruth, Whitman, Portwich,[37] Fromme [38] and others have reported many cases of bony union following treatment of medial fractures of the neck of the femur. On the whole, therefore, it is evident that modern methods of treatment of hip fractures including exact apposition of the fragments, prolonged fixation and protection of the injured hip for several months from strains, and weight bearing has resulted in an increase in the percentage of cases with bony union and good functional results.

The therapeutic value of posture in the treatment of many diseases is practically universally recognized. The prone position of Schintzler for

acute dilatation of the stomach is quite generally accepted as an effective means of relieving this condition. Elevating the head of the bed as an adjunct to the management of patients with decompensated hearts, acute pulmonary conditions and diffuse peritonitis are therapeutic methods which have been in common practice for well over a century.

In recent literature on hip fractures frequent reference to the value of posture as an adjunct to the treatment of this injury is found. Whitman raises the head of the bed and turns the patient on each side and on the face to promote better circulation and prevent hypostatic pneumonia. Dorrance and Murphy, who are using the Whitman abduction method, get patients out of doors in a wheel chair a few hours each day after the third week of treatment. Campbell and Portwich mention the use of a chair in which patients treated by the Whitman straight spica case may sit.

FIG. 4.—No. 1493. Application of flexed spica, using "spica box."

Practically all writers on hip fractures in the past have concurred in the opinion that dorsal recumbency was a necessary adjunct to the successful management of these patients. A few cases have been reported in which a straight hip spica case or Thomas hip splint and crutches have been used throughout treatment with good results. These methods, however, are adaptable to the strong, robust individual, but are quite unsuited to the aged, debilitated patient so frequently the victim of a hip fracture.

For several years I have been interested in various problems involved in the most satisfactory management of hip fracture cases and in 1916 suggested a method of treatment in which the fracture was reduced and the injured leg was placed in a position of abduction, flexion and internal rotation or approximately in a normal sitting position, and so held by a plaster spica case during the period of healing. (See Figs. 1 and 2.) In this way patients could be up in a wheel chair every day throughout the fixation period of their treatment. The results were encouraging both as regards the physical condition of the patient while undergoing treatment and the ultimate function of the injured hip. In 1921, I published a second article reporting a series of 42 cases with the so-called "flexed spica". In this series of cases there were 25 which recovered with good functional results, 2 died during treatment, 11 recovered with considerable disability, and 4 were lost trace of.

In a series of cases by Campbell in 1919, he mentioned applying a plaster

case in three cases with the leg in abduction, flexion and internal rotation to "facilitate early sitting position". Judet, of Paris, in 1921 reported the use of a case identical to that which I have used. (See Fig. 3.)

My results since 1921 have continued to be satisfactory and seem to warrant a detailed description of the method as it is now being used.

Ether or morphine and scopolamine anæsthesia was generally employed until recently for reduction of the fracture and application of the case. In fourteen of my late cases, spinal anæsthesia was substituted. Manipulation of the fragments and maintenance of the fixed position during the application of the case are carried out more easily with this anæsthetic than with ether owing to the more complete relaxation of the muscles. Post-anæsthetic vomiting did not occur, and the patients were able to take food earlier than when ether was administered. Therefore, at least, in the case of feeble patients, spinal anæsthesia appears to offer certain advantages.

FIGS. 4 and 5.—No. 1493. Fracture reduced. Case applied.

It is surprising to find but few references in the literature to the employment of spinal anæsthesia in the reduction of hip fractures. Adams,[39] in 1921, reported its use in five cases, Robineau and Contremoulins refer to it in their cases of hip fracture requiring operative treatment. Portwich also mentions it but does not state how extensively he uses it.

I now use in reduction of these fractures a modification of the method described by Robineau and Contremoulins. Their method briefly described consists in a double fulcrum in the groin, longitudinal traction on both legs and abduction and inward rotation of the injured leg, thus stretching the capsule of the joint and forcing the fragments into close apposition. There would seem to be no question but that a more accurate apposition of the fragments can be obtained by this method than by the older methods of reduction.

Instead of using double perineal supports or fulcrums described by

Robineau and Contremoulins, I have bandaged the patient firmly to the sacral support of a spica board; then after the usual manipulation of the fractured hip to separate the fragments of bone and to release any interposing tissues between the fragments, lateral traction on the hip has been exerted while an assistant made traction in the longitudinal direction and forcibly inverted the leg. The position of the fragments is then verified by antero-posterior and stereoscopic X-ray plates.

FIGS. 4 and 5.—No. 1493. Röntgenogram before reduction.

After the reduction is completed an assistant holds the uninjured leg with the knee and hip flexed at right angles and the thigh abducted as far as possible. This serves partly as a counter-traction to the force exerted upon the injured leg during the application of the case. While longitudinal traction is still maintained on the injured leg, the position of the leg is gradually changed until the knee is flexed at right angles and the thigh flexed at right angles with the body. During this change in position, care is taken to maintain a position of forced internal rotation of the leg. The longitudinal traction on the injured hip has now been changed to practically a vertical traction. The leg is now abducted as far as possible and is maintained in this position during the application of the case.

I have demonstrated that the above-described position (Figs. 4 and 5) utilizes the capsular ligaments and muscles about the hip-joint, which maintain apposition of the fragments of the neck of the femur after reduction has been accomplished. Abduction of the hip puts the anterior ligaments of the capsule and abductor group of muscles about the joint on stretch. Forced internal rotation of the thigh overcomes the eversion of the leg resulting

from the action of the obturator externus and the short external rotator muscles. (Figs 6 and 7.) Flexion of the hip puts the gluteus maximus and medius on stretch, thus forming a strong hammock, supporting the great trochanter and preventing backward displacement or eversion of the thigh. (Fig. 8.)

Upward and outward traction, abduction and internal rotation of the injured leg are maintained by an assistant while a single plaster spica bandage is applied from the nipple line of the chest to the calf of the injured leg. After this portion, if the case has set, all traction is released and the remaining part of the case from the calf to the toes is applied. It is necessary to reinforce the case heavily in the groin to avoid breaking in this region. Considerable care is also required in applying the case about the buttocks to withstand the pressure on this portion of the case in sitting.

FIG. 5.—No. 1493. Flexed spica completed.

During the first few years of using this method, the bandage was carried down to the calf of the leg. Since marked swelling of the leg and foot often resulted, it has seemed better to advise extension of the bandage to the toes.

The day following the application of the case, the patient sits up on the side of the bed with the back support and feet on a stool. Each day thereafter as long as the case is worn the patient sits on the side of the bed with feet on a stool or is out of bed in a chair. Patients are thus able to wait upon themselves to a considerable extent and busy themselves in many ways that they would be unable to do if they were in bed. They require a minimum of nursing care. Bathing and care of the back before getting up in a chair in the morning, and assistance in returning to bed at night constitute the more important duties of the nurse.

It is a rare occurrence for the patient to remain in the hospital throughout treatment with the flexed spica. Most patients are discharged from the hospital to their homes two or three weeks after the application of the case to be cared for by members of their family or by a trained nurse. To the family of moderate means, the reduction in hospital bills, by this method of treatment, is an appreciable saving.

In the early cases of medial fracture in my series, the case was removed at the end of eight weeks. In some aged patients the results were unsatisfactory owing to fibrous or weak bony union.

The period of fixation should be at least twelve weeks in medial fractures

and in old, feeble patients, sixteen weeks if the treatment is well borne. After the removal of the case, from two to six weeks should be spent in bed, gradually regaining the use of the leg. Active exercise should be attempted first, later followed by passive motions and massage.

Any strain upon the injured hip should be prevented, on getting up, by the use of a walking brace of the Jones type, the type described by Dorrance and Murphy or some similar protective apparatus.

FIG. 6.—The usual position of the distal fragment in a loose medial fracture, resulting from the action of the glutei, obturator externus and short external rotators of the thigh.

In certain cases in which a firm bony union is known to exist, weight bearing can be safely undertaken at the end of eight months; but in the majority of patients past middle life with a medial fracture, full weight bearing cannot be undertaken safely for at least a year from the beginning of treatment.

Four illustrative case reports are offered:

1. Moore Hospital, No. 111, male, aged seventy-five, November 24, 1917. About twenty-four hours before admission he slipped on the ice and fell, injuring his right hip. He was still in considerable shock and having involuntary urine. A rather feeble, shaky old man, blood-pressure 160–90 with nothing remarkable in his general physical examination. A slight trace of albumen and a few casts in his urine. His right leg was everted 45 degrees, shortened 1½ inches; he was unable to raise it from the bed and there was a relaxation of the ilio-trochanteric band of fascia. The X-rays showed an impacted medial fracture of the neck. On November 29, under gas oxygen, the fracture was reduced and a "flexed spica" case applied. He was up in a wheel chair daily until the case was removed February 19, 1918. After the removal of the case he was kept in bed for three weeks and given massage, active and then passive motion. Gradually he got about and September 15, 1918, he was walking with one cane without limp or pain in the injured hip.

2. Moore Hospital, No. 1026, male, aged fifty-nine, July 25, 1921. Three hours before admission he fell from a load of hay to the ground, striking on his left hip. He was a strong, robust man, suffering severe pain in the region of the left

hip. The pain was markedly increased on motion of the hip. He had no eversion or shortening of the left leg. X-rays showed a lateral fracture of the hip without displacement. A "flexed spica" case was applied under ether. August 14, 1921, he was discharged to his home, having been up in a chair daily since the case was applied. October 1, 1921, case was removed, he was kept in bed two weeks thereafter. Then got up on crutches and gradually began weight bearing on the injured leg. January 15, 1922, walking without support or limp.

3. Moore Hospital, No. 1672, female, aged eighty-six, August 8, 1922. July 25, 1922, patient was hit by an auto, which pushed her down, injuring the right hip. She had been in bed with the head raised for two weeks and a hopeless prognosis given

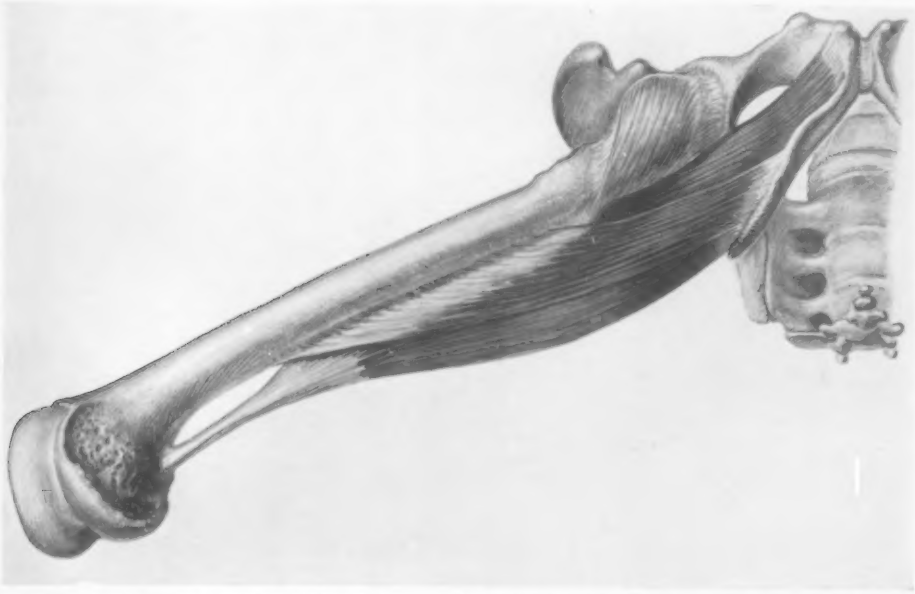


FIG. 7.—Showing the action of the adductors and capsular ligaments in the dissected subject in holding the fragments in apposition, after reduction, in the flexion abduction and internal rotation position before applying the flexed spica case.

by the family physician. On examination she was found poorly nourished, feeble, shaky, had moderate cough, numerous râles in base of each lung, slightly cyanotic, pulse rapid, poor quality, intermittent, blood-pressure 110–60. X-rays showed impacted medial fracture neck of right femur. She was put upon a high back rest and stimulants administered. August 22, she had improved to such an extent that the fracture was reduced and a "flexed spica" case applied under spinal anæsthesia. She sat up on the edge of the bed and in a chair each day until the case was removed December 1, 1922, at that time X-rays showed excellent union. She was kept in bed the usual three weeks for massage and motion after the removal of the case and then gradually got up and about with crutches and a crutch splint. She was not seen again until September 15, 1923, at which time she was walking without crutches or cane and only had a slight limp.

4. Moore Hospital, No. 2608, male, aged fifty-three, February 6, 1925. A few hours before examination patient fell on the ice, injuring his right hip. He was in excellent physical condition except for the injury to the right hip and ankylosis of the right knee at 45 degrees flexion which resulted from an old injury. Complained of severe pain in the right hip, moderate eversion of the leg with about one inch shortening. X-rays show a lateral fracture with moderate displacement. The following day the fracture was reduced under spinal anæsthesia and a "flexed spica" case applied

with the knee in the ankylosed position. He was discharged to his home one week after the application of the case. On returning home he walked with crutches, got in and out of the wagon and did nearly all of his work about the farm. April 15, the case was removed and he walked about with crutches for a few weeks but soon discarded them. June 15, he was walking as well as before the injury.

SUMMARY

There is still considerable divergence of opinion among recent writers on hip fractures regarding the most satisfactory method of treating this injury. Active methods of treatment, including abduction, appear to be more generally accepted than any other.

The view expressed by many writers that medial fractures of the hip never unite by bony union is incorrect. The chief factors in delayed or non-union following medial fractures are injury to the blood supply to the fragments of bone, slow formation of callus which is endostial in origin, imperfect apposition and fixation of the fragments and too early weight bearing.

Posture is an important adjunct to the treatment of hip fractures in aged, feeble patients.

The "flexed spica" treatment of fractures of the hip allows patients to assume a sitting position during the period of repair of the fracture while the hip is fixed in position of flexion, abduction and internal rotation. This method of putting up hip fractures has proved remarkably satisfactory in a large series of cases. The details of its application are described.

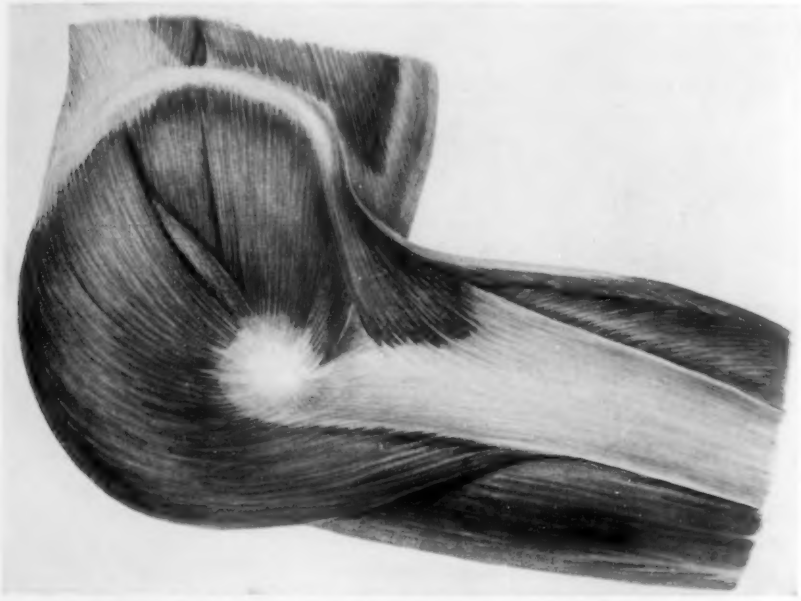


FIG. 8.—The glutei in the flexed position acting as a strong hammock back of the great trochanter.

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THE UNTOWARD EFFECTS OF NARCOTICS AND ANÆSTHETICS UPON ROBUST AND HANDICAPPED PATIENTS*

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The ideal anæsthetic is one causing the patient only slight discomfort, affording a depth of anæsthesia under which operative procedures can be carried on easily, and producing minimal injurious effects.

The short induction period of nitrous oxide and ethylene with almost no sensation of asphyxia contrasts rather strongly with the prolonged discomfort caused by ether. Nausea, so frequent after ether, is less common with ethylene or nitrous oxide, and when it does occur is of short duration. Post-operative pain, especially when there is an abdominal incision, is intensified by vomiting and, therefore, is worse following ether.

The muscular relaxation that permits of rapid work in the abdomen is more easily obtained with ether. Coöperation of the surgeon and anæsthetist when working with ethylene or nitrous oxide can diminish this advantage. Gentle handling of tissue, a few minutes' warning before upper belly manipulation, an incision that gives exposure without violent retraction enable an anæsthetist to provide adequate relaxation with ethylene. Nitrous oxide alone seldom will induce a depth of anæsthesia sufficient for laparotomy without some cyanosis.

Nitrous oxide and ethylene probably produce no direct injurious effect upon the lung. Pneumonia and bronchitis occur, but no more frequently than would be expected following operations under local anæsthesia. A large proportion of pulmonary complications are embolic in origin and, therefore, not attributable to anæsthesia. We are using ethylene on patients having pulmonary tuberculosis and bronchiectasis with no incidence as yet of acute inflammatory reaction. The number of pulmonary complications following ether is appreciable and in the debilitated is of sufficient frequency to be nearly prohibitive.

Intestinal stasis, paralytic ileus, and dilation of the stomach, although caused principally by operative manipulation, are in part due to anæsthesia. When ethylene is used exclusively, there is little gastric dilation. Post-operative distention is not frequent and is seldom severe. When ether is the anæsthetic, gastric lavage is a common necessity. The annoying thirst subsequent to ether, often unsatisfied because of gastric upsets, rarely occurs after ethylene or nitrous oxide for fluids usually can be taken in generous

* Read before the American Surgical Association, May 13, 1927.

amounts the day of operation. Miller (*Jour. Pharm. and Exper. Therap.*, 1926, vol. xxvii, p. 41), in demonstrating the effects of anæsthetics upon peristalsis and gastro-intestinal tone, supplies the explanation. During ether anæsthesia, peristaltic action is abolished and muscular tone is diminished. Recovery is slow and it is hours before normal activity is resumed. The tone of the stomach returns more slowly than that of the small intestine while the colon is frequently in a state of spastic contraction. Nitrous oxide does not alter peristalsis or muscle tone unless cyanosis develops when the peristaltic waves may be abolished or become tumultuous. Ethylene produces no change in gastro-intestinal activity either during or after anæsthesia.

Chloroform, ether, and nitrous oxide cause tissue changes. Cloudy swelling and granular degeneration are evident in heart, liver, and kidneys. Stander (*Am. Jour. Obst. and Gyn.*, 1926, vol. xii, p. 633) has found that anoxæmia alone causes degenerative changes in liver cells. Ethylene produces slight changes in liver while he finds no demonstrable lesions in the kidney. Studies made by Davis show slight œdema in kidneys.

During and after anæsthesia there are abnormal variations in the blood's acid-base balance. Leake and Hertzman (*Jour. A. M. A.*, 1924, vol. lxxxii, p. 1162), Stander (*Am. Jour. Obst. and Gyn.*, 1926, vol. xii, p. 633), and numerous others have reported these changes. Our findings agree with theirs. There is an increase in the hydrogen-ion concentration, a decrease in alkali reserve as measured by the carbon-dioxid combining power, an increase in sugar, an increase in lactic acid, and usually an increase in phosphates. Chloroform and ether produce the greatest change while that caused by nitrous oxide is inversely proportional to the percentage of oxygen. Ethylene causes the least change in any of these blood constituents.

The mechanism whereby these changes occur is still in doubt, yet some steps in the process are known. Stander (*Am. Jour. Obst. and Gyn.*, 1926, vol. xii, p. 633) and others have shown that anoxæmia produced by breathing an atmosphere of 7 per cent. oxygen lowers the carbon-dioxid combining power and raises the blood sugar. Evidently oxygen deficiency is a cause of acidosis. Ronzoni, Koechig, and Eaton (*Jour. Biol. Chem.*, 1924, vol. lxi, p. 465) find that the increase in lactic acid accounts for part of the increased hydrogen-ion concentration and the lowered alkali reserve. The increase in phosphate, according to Stehle and Bourne (*Jour. Biol. Chem.*, 1924, vol. lx, p. 17) comes from muscle as phosphoric acid and aids in lowering the pH of the blood. These findings would explain the acidosis following nitrous oxide when cyanosis occurs, but hardly accounts for that produced by ether and chloroform when the oxygen in the inspired mixture is adequate. Apparently one effect of anæsthesia upon metabolism is a slowing-up of oxidation. The cells are unable to utilize the oxygen carried to them. Lactic acid is not oxidized quickly to carbon-dioxid and water because the process is inhibited by the anæsthetic. An anoxæmia, therefore, exists, although the actual amount of oxygen in the blood is within normal limits.

Thalhimer and Raine have shown that acidosis interferes with carbo-

hydrate metabolism to such an extent that a patient in post-operative acidosis maintains an elevated blood sugar under doses of insulin that would cause violent insulin shock in a healthy individual. The acidosis then may account for the increase in sugar.

Clinically, we see these changes in the acid-base balance as post-operative acidosis. Ether and chloroform are the principal offenders. The vomiting that starts immediately after operation continues because of the acidosis. The further loss of fluid and the lack of food make a vicious cycle.

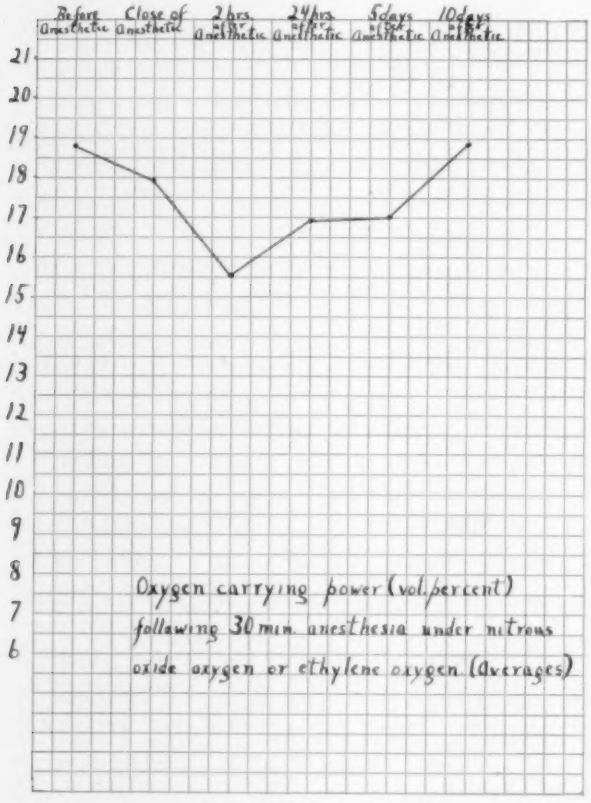

FIG. 1.

The danger of chloroform and ether in diabetes is too well realized to need repetition.

In robust individuals minor changes in acid-base balance are quickly compensated, but, in the debilitated, acidosis may mean the difference between recovery and death. Ethylene, clinically and experimentally, has proved the least injurious, for there is less actual and inhibitory anoxæmia.

Ether, chloroform, nitrous oxide, and ethylene diminish the oxygen-carrying power of the blood. Oxygen-carrying power, measured by the Van Slyke method, is one of the most accurate means of determining hæmoglobin. There is, therefore, a destruction of hæmoglobin, or at least a change in hæmoglobin rendering it incapable of carrying oxygen. The accompanying chart shows the average amount of reduction in oxygen-carrying power in healthy individuals subjected to one-half hour's anæsthesia under ethylene and nitrous oxide. (Fig. 1.) The entire decrease does not occur immediately, but develops between one and twenty-four hours and is from 10 per cent. to 25 per cent. of the initial figure. The return to normal requires from five to ten days. Seriously sick or anæmic patients show a proportionately greater decrease than the robust. Blood counts show some drop in red blood corpuscles, but the decrease in numbers is not enough to account for the diminished oxygen-carrying power.

The fate of the hæmoglobin is obscure. It is not excreted in the urine in a form or quantity sufficient to be measured. The icterus index is very high a few hours after ethylene and nitrous oxide. (Ether and chloroform have not been studied.) The increase amounts to from two to three times the normal, beginning during the anæsthesia and reaching a peak from one to six hours later. A high icterus index has been found in fasting subjects only when there is increased blood destruction, as in pernicious anæmia, or in diseases of the liver or bile ducts when the bile content of the blood is augmented. Absorption of blood from wounds or from the peritoneal cavity will raise the amount of destroyed hæmoglobin in circulation. There is hardly enough liver injury following anæsthesia to account for this elevated icterus index, and, since it is elevated without operation, the increase is due to more rapid bile pigment production following hæmoglobin destruction.

Anoxæmia, produced in a dog by forcing it to breathe an atmosphere of 93 per cent. nitrogen and 7 per cent. oxygen, although causing changes in the acid-base balance similar to those following anæsthesia, does not cause a fall in oxygen-carrying power. The alteration or destruction of hæmoglobin must be the direct effect of the anæsthetic.

A patient whose oxygen-carrying power dropped 20 per cent. following the drainage of an abscess under ethylene was given a blood transfusion the next day. Five hundred cubic centimetres of whole blood brought the oxygen-carrying power back to the initial figure, thus compensating for twenty-five minutes' anæsthesia and rather insignificant operative trauma. Blood from a patient on whom an appendectomy was done under novocain infiltration showed that the operative trauma and the loss of blood do not decrease the oxygen-carrying power as much as thirty minutes' anæsthesia without an operation.

Our data on anæsthesia without operation are too limited to permit us to draw conclusions as to the comparative effects of the different anæsthetics. Apparently chloroform causes the greatest drop while the decline in oxygen-carrying power following ether, ethylene, and nitrous oxide is about the same.

The effect of this loss of intact hæmoglobin in robust patients is of only slight importance. A drop of 15 per cent. to 25 per cent. in the oxygen-carrying power of anæmic individuals or of those whose heart load is already maximal may mean a break in cardiac compensation.

The sedimentation rate of erythrocytes, with the possible exception of the total lymphocyte count, is the best single measure of the unknown quantities we term defense. The factors determining the sedimentation rate are principally in the plasma, but we know neither the mechanism nor the actual chemical and physical factors governing this rate. Conditions one would expect to retard the rate do not. Blood from severe diabetics or from those in uræmic coma, instead of sedimenting slowly, does so rapidly. A patient in severe shock when the red blood count is above five millions, so that there is considerable concentration, has a rapid rather than a slow rate. The rate

in eclampsia is much more rapid than that after ether anæsthesia, yet the known blood elements are almost identical. Although the physical reason for a slow or rapid sedimentation rate is unknown, the meaning is definite and reliable. Whether the disease be acute or chronic, bacterial or parasitic, a malignant tumor or a disturbance in a gland of internal secretion, the divergence from the normal rate is an index of resistance and defense, a measure of antibodies, hormones and chalones.

Anæsthesia increases the rate of sedimentation. The accompanying chart shows the variation from the normal produced in a healthy individual by a half-hour's anæsthesia. (Fig. 2.) The amount of variation is not always the same, but following ether, nitrous oxide, and ethylene (chloroform not done) there is an increase in rate. The return to normal is slower than the return of all the other blood elements altered by anæsthesia. Anoxæmia, although producing an acidosis, does not noticeably increase the rate of sedimentation.

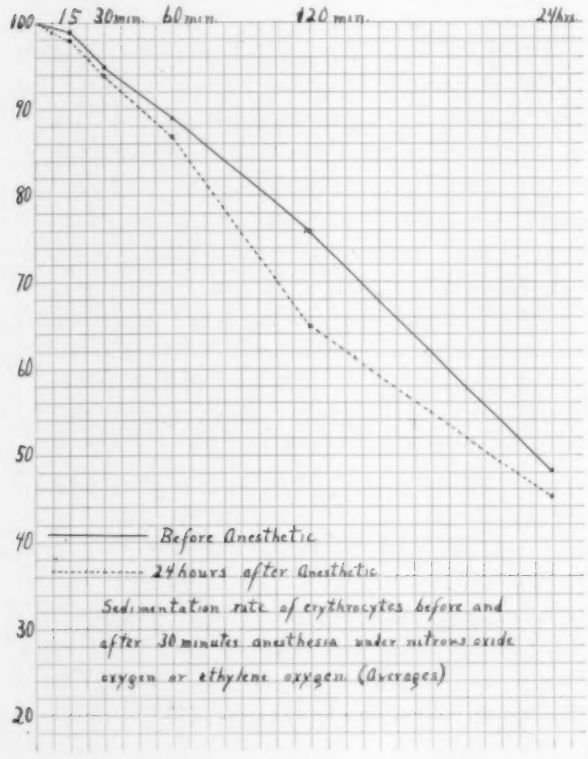

FIG. 2.

Observations on healthy individuals under different anæsthetics are too few to warrant conclusions as to the comparable effects. The clinical significance of an increased sedimentation rate may not be clear, but we can be sure that following anæsthesia there is impairment of resistance, defense, and repair.

Opiates produce a slight alkalosis and so counteract in part the acidosis caused by anæsthetics.

The depth of anæsthesia afforded by nitrous oxide and ethylene is frequently insufficient for abdominal operations and attempts to produce greater relaxation by decreasing the percentage of oxygen lead to increasing anoxæmia and, therefore, increasing acidosis. Preliminary narcosis enables the anæsthetist to provide adequate relaxation for upper abdominal operations with concentrations of from 15 per cent. to 25 per cent. oxygen in ethylene. An even depth of anæsthesia is essential not only for rapid oper-

ating, but also for the welfare of the patient. Preliminary narcosis makes this possible.

The relative merits of morphin and pantopon as pre-operative drugs are no longer in doubt. There is less nausea with pantopon before the anæsthetic begins and less vomiting during the induction period. There is no appreciable difference in the post-operative period. The disagreeable sensations induced by opiates seem to be less with pantopon than with morphin.

Observations on the effects of anæsthetics with and without preliminary narcosis are too few to make definite assertions, but they seem to be less severe and the return to normal is more rapid when narcotics are used.

The untoward effects of anæsthetics are multiple and varied. The ideal anæsthetic is still in the future. Ethylene, with from one-half to two-thirds of a grain pantopon an hour and a half pre-operatively, more nearly approaches the ideal than ether, chloroform, or nitrous oxide.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held October 10, 1927

The President, Dr. Charles F. Mitchell, in the Chair

TOTAL CARCINOMA OF RECTUM

Dr. Hubley R. Owen demonstrated a specimen consisting of the rectum and part of the sigmoid, which showed total carcinoma. This had been removed a few hours before by the abdomino-perineal route from a patient who had had symptoms for only a few weeks.

SPLENECTOMY FOR BLOOD DYSCRASIA

Dr. A. P. C. Ashhurst presented a woman, a patient of Dr. Alfred C. Johnson, aged fifty-one years, whose spleen had been removed by Doctor Ashhurst at the Episcopal Hospital, June 1, 1927. The patient had entered the hospital after a few months' illness, suffering from jaundice and anæmia, the diagnosis being acquired hæmolytic icterus. Her improvement after the operation was rapid and she is now in very good health.

Also a female child, a patient of Dr. William H. Crawford, aged seven years, whose spleen had been removed by Doctor Ashhurst at the Episcopal Hospital, March 5, 1925, for chronic purpura hemorrhagica. She had had attacks of purpura for a year or more and had been in the hospital on four former occasions. Her improvement after the splenectomy was immediate. She has had no return of her bleeding and has remained in excellent health.

Dr. James E. Cottrell said that the woman presented by Doctor Ashhurst was under his care in the medical ward. The salient points in the condition at that time were jaundice, anæmia of the secondary type and increased fragility of the red cells. There are two types of hæmolytic icterus, namely, the congenital and the acquired. Congenital types are by far the milder. They may persist for years and the patient suffer little from the condition, the health being interrupted at times by blood crises in which hæmolysis of the red cells with severe anæmia takes place. This is followed by return to the usual state of slight anæmia. In the acquired type, the cause of which is still unknown, a more severe condition obtains which progresses usually to a fatal termination, if not interrupted. The treatment indicated is splenectomy, which usually results in recovery. This patient had anæmia of the secondary type. No obvious source of hemorrhage could be found to account for such anæmia. In this case a most useful adjunct was the administration of a liver diet as outlined by Minot and Murphy, of Boston, which is useful not only in the treatment of pernicious anæmia—for which it was originally suggested—but for almost any severe anæmia. This case was an example of the comparative hopelessness of the condition

if allowed to run its usual course, and the excellent results which can be obtained by splenectomy, although the physiology of the process is shrouded in mystery as is the physiology of the spleen in general.

Dr. A. P. C. Ashhurst said, in referring to the patient with purpura hemorrhagica, that he had been surprised that although the child had been in the hospital three times before no one else on the surgical staff had taken her spleen out. These patients with chronic purpura are known to be curable by splenectomy; the mortality is low and the results are admirable. In acute cases, however, the mortality is very high, and splenectomy is rarely if ever justifiable.

As to the adult woman, there is still some dispute among the pathologists and clinical men as to whether it is a case of pernicious anæmia or of hæmolytic icterus. He believes it is the latter, and the patient has certainly been vastly improved by the removal of the spleen. There is nothing mysterious or miraculous about the operation of splenectomy; if the spleen is diseased, the surgeon removes it; if the pathologist cannot determine by histological study of the spleen after it is removed the exact nature of the disease, that is the misfortune of the pathologist.

RUPTURE OF BOWEL AT THE DUODENO-JEJUNAL JUNCTION

Dr. E. L. Eliason reported the case of a man, twenty-six years of age, who was admitted to Service C under the reporter's care at the University of Pennsylvania Hospital, at 11 P.M., May 7, 1927, complaining of abdominal pain associated with nausea and vomiting. He gave the history that while at work at a buzz saw at 8 o'clock that morning he was struck in the left upper abdomen with the end of a long plank, eight inches wide, thrown from the revolving saw. He was unconscious for a few moments. Since that time he has had severe pain in his upper abdomen with continuous nausea and vomiting. His physician gave the information that he was subject to epileptic attacks. On admission the T.P.R. was 99–84–24 with a blood-pressure of 110/70. The blood picture showed white blood-cells 20,400 and the man looked "hard hit." The abdomen presented a contused area the shape of the end of the plank over the left upper abdomen, extending from the tenth costal cartilage almost to the midline. The abdominal muscles were board-like in their rigidity and peristalsis was absent. There was generalized tenderness and pain. A tentative diagnosis of a ruptured hollow viscus (jejunum) was made. Operation was performed sixteen hours after the accident. The abdomen was opened through an upper paramedian incision. The peritoneum was markedly injected and filled with lymph and fluid. On delivering the great omentum and transverse colon, much of the patient's partially digested breakfast was found among the jejunal loops. Further examination disclosed a ragged tear about three inches long extending obliquely from in front of the first inch of the jejunum near the mesentery around the free border and across the posterior wall of the last one and one-half inches of the duodenum. In a word, the wound circumscribed the gut spirally, with the exception of a strip about three-quarters of an inch wide at the mesenteric attachment. The tear was closed by a double row of sutures and the abdomen then flushed free of food with salt solution and drained suprapubically and locally.

The patient left the operating table with a pulse of 156, but reacted

promptly and experienced a very smooth convalescence until the afternoon of the seventh day, when he had an epileptiform convulsion which lasted six hours. A few hours later, because of its being blood stained, the abdominal dressing was removed thereby disclosing a ruptured wound with omentum and a loop of jejunum 10–12 inches long lying on the anterior abdominal wall. Under gas anæsthesia these viscera were replaced and held within the abdomen by packing, no attempt being made to suture the wound. Three weeks later the granulating wound was grafted by the Reverdin method. The patient was discharged June 18, 1927, in good condition.

At the follow-up three months later he was credited with being in perfect health.

Doctor Eliason remarked that this case belonged to that group termed by Sternberg, of Vienna, as "Zureckschlagen" or "kickback". L. P. Kuhn, of Chicago, in 1925 reported the following statistics to date: He quotes Sternberg as stating "that woodworkers using the revolving saw (2000 to 3000 revolutions per minute) are very prone to injuries by the wood being thrown or kicked back by the saw. In Austria of 519 accidents caused by planing machines, 221 were due to kickback. Of 135 accidents by trimming machines, 85 were due to the same, and of 514 circular saw accidents, 204 were of similar cause. Kuhn reports 55 "kickback" accidents from a ripsaw or planer. Monro states that a hollow viscus filled with food is the commonest ruptured and of these the jejunum and ileum predominate. Massie reviewed 34 cases of ruptured viscus and found the greater number occurred in the jejunum and ileum. Most cases were partial ruptures rather than a complete division of the gut. J. T. Bottomley, writing on injuries of the jejunum and ileum states that unfortunately the early symptoms may not be of serious significance." In the experience of the above writers many of these patients have either continued to work or have returned to work in an hour or so, only later reporting abdominal distress. This was the case with his patient.

BULLET WOUNDS OF BOWEL AND OF ILIAC VEIN

Dr. E. L. Eliason presented a boy, aged thirteen years, who was admitted to Service C, under the reporter's care, at the University of Pennsylvania Hospital, January 18, 1927, giving the history that four hours previously he had been shot in the abdomen by a .22-calibre rifle bullet. On admission the T.P.R. was 98.3–100–24 and the blood-pressure 110/70. The blood count showed 12,500 white blood-cells and 60 per cent. hæmoglobin. The record of the red blood-cell count was lost.

The patient, although having considerable generalized abdominal pain, had not vomited. There was no restlessness, thirst, air hunger or apprehension. The skin was warm, but it, and also the mucous membranes, were pale. Examination of the abdomen revealed a bullet wound in the midline two inches below the umbilicus. The abdominal walls were quite rigid, peristalsis was absent and there was movable dulness in the flanks. The tentative diagnosis was that of intraperitoneal injury with hemorrhage, and operation was undertaken at once.

The abdomen was opened about the wound, which was débrided en route. When the peritoneum was opened, considerable blood was evacuated. Eight through-and-through perforations of the small gut, making sixteen wounds, were found. They were sutured with silk. One wound of the gut which

did not perforate the muscular coat was also closed. Wounds in the mesentery were sutured. Bleeding points were caught and ligated. Further investigation of the abdomen showed no further wounds in the small gut, but there was a single perforation of the sigmoid with considerable laceration of the meso of the sigmoid. These wounds were closed. Further examination revealed a wound in the posterior parietal peritoneum over the left pelvic brim where the great vessels cross it, which bled profusely. It was found to be a vein of considerable size, probably one of the iliacs at the bifurcation of the artery, but positive identification was not made. The wound was found to have practically severed the vein. Both ends were ligated. He was transfused with 250 c.c. of citrated blood after his return from the operating room. The post-operative course was uneventful. The wound remained clean and the patient was discharged on the fourteenth day after operation. Examination three months later showed the wound perfectly healed, no swelling of the limb and the patient said that he had no complaints.

ACUTE SUPPURATIVE PANCREATITIS

Dr. L. K. Ferguson, by invitation, reported the case of a woman aged forty-five, who was admitted to the University of Pennsylvania Hospital in January, 1927, in the service of Dr. E. L. Eliason. The patient gave a history of having been in good health until 1925, when she had an attack of sudden severe epigastric pain accompanied by nausea and vomiting. A similar but somewhat less severe attack occurred four months later. Before and after these attacks the patient felt quite well, except for occasional "heartburn" which was relieved by soda. In January, 1927, a third attack occurred. There was no elevation of pulse rate or temperature and the pain was relieved by an injection of morphine. The vomiting continued and the pain became localized to the left hypochondrium with some radiation to the back. On admission her temperature was 99.4°, pulse 92, respirations 28, blood-pressure 160/70. The pain was intermittent and was confined almost entirely to the upper left abdomen. The whole abdomen was tender, especially in the left hypochondrium, and there was a slight rigidity of her left upper rectus. No masses could be palpated. Peristalsis was still present. The leucocyte count was 19,300. Because of continued pain and vomiting with increasing leucocytosis, operation was elected. As soon as the peritoneum was opened, chocolate-colored fluid escaped and several small patches of fat necrosis were seen. By elevating the colon, the posterior abdominal wall was revealed, disclosing considerable hemorrhage and retroperitoneal fat necrosis, especially on the left side. The pancreas was then exposed through an opening in the gastro-colic omentum; on opening the capsule of the gland, thin blood-tinged necrotic material escaped. The pathology seemed to be largely confined to the left side in the tail of the organ. Drainage was instituted. Her convalescence was marred somewhat by a right basal broncho-pneumonia from which she quickly recovered. She was discharged five weeks after operation, with the wound still draining slightly. She weighed 95½ pounds on the day of her discharge. During convalescence, the patient was watched for signs of diabetes. On the day after operation the blood sugar was 137 mgm. per 100 c.c., falling to 93 mgm. on the twelfth day. Sugar never appeared in the urine. Since her discharge, the patient has gained weight and is now in good health. This case presents several unusual and interesting features. (1) Three attacks of probable pancreatitis, with an interval of one and one-half years before the last attack. (2) Loss of weight, probably due to a chronic pancreatitis. (3) A final attack without the usual shock associated with an acute pancreatitis. (4) Pain and

tenderness confined almost entirely to the left upper side. (5) Pathology involving only the tail of the pancreas. (6) Recovery following drainage of the organ.

Dr. A. P. C. Ashhurst asked Doctor Ferguson how soon he withdrew the drainage in his case of acute hemorrhagic pancreatitis. Doctor Ashhurst had lost his first patient with acute pancreatitis, he believes, because he withdrew the drain too soon, forgetting that in pancreatic disease there is inhibition of adhesion formation; the pancreatic ferments prevent adhesions. The afternoon on which this patient had the drain removed, about the fourth day after operation, she developed general peritonitis and died a day or so later.

Dr. L. K. Ferguson said in reply that his patient had the pathology located almost entirely in the left side; as soon as the gastro-colic omentum was opened the lesion was apparent. Two kinds of drains were used: a split rubber tube, containing a wick, and a tube of soft rubber. One split rubber tube extended to the tail of the pancreas and the other was placed into the opening in the gastro-colic omentum. These were both coffer dammed with the soft tubes; four of the latter being used. The soft tubes were taken out gradually and removal completed in one week. The other tubes were allowed to remain for fifteen days.

UNILATERAL BRONCHIECTASIS—EXTRAPLEURAL THORACOPLASTY

Dr. John B. Flick reported the case of a woman aged thirty-seven, who was referred by the Jackson Clinic to the Surgical Service of Dr. John H. Gibbon at the Jefferson Hospital in November, 1926, with the history that when five years of age she sucked into her lungs a coffee bean with the result that she became quite ill with an attack simulating pneumonia. One month after the onset, she coughed up the bean and her condition improved materially, but she never got rid of the cough. When eighteen years of age she was told she had bronchiectasis. For the past eighteen or nineteen years, she has had almost yearly attacks of severe acute infection of the respiratory tract. From March, 1925, until she was operated upon, she was confined to her bed almost continuously, had a fetid expectoration and brought up small amounts of dark blood on the slightest exertion. Prior to her admission to the surgical wards, she was studied by Dr. Louis H. Clerf of the Jackson Clinic and bronchoscopic treatment undertaken. Under bronchoscopic drainage her general condition improved. She gained in weight, brought up less sputum, and the fetid odor was definitely lessened. Bronchoscopic examination showed quantities of pus coming from the left bronchus. Iodized oil was introduced through the bronchoscope and Röntgen-ray studies made which showed extensive bronchiectasis and pulmonary fibrosis, involving the lower lobe of the left lung and a portion of the upper lobe. (Fig. 1.) Repeated sputum examinations failed to show tubercle bacilli. The amount of sputum at the time of the first operation varied from seventy-five to one hundred and twenty-five cubic centimetres in twenty-four hours. The temperature was normal, with occasional periods of low-grade fever.

November 19, 1926, under local infiltration (one-half of one per cent. novocain) anæsthesia and nitrous-oxide oxygen analgesia, through a posterior incision, sections of the eleventh, tenth, ninth and eighth ribs were

removed. Following this operation the sputum diminished about a third in amount. December 3, sections of the seventh, sixth, fifth and fourth ribs were removed. December 13, sections of the third, second and first ribs were removed. Following this she was sent to a Convalescent Home for two weeks.

January 31, 1927, she was readmitted to the Jefferson Hospital for further study. She had gained eight pounds in weight and was up and about for the first time in two years. Doctor Clerf again introduced iodized oil through a bronchoscope, and Röntgen-ray studies were made to determine if possible to what extent the bronchiectatic cavities had been collapsed. It was decided that further resection of ribs would be necessary. This was done in two stages. February 21, sections of the eleventh, sixth, fifth and fourth ribs, from the point of previous section to the costochondral junction, were removed through an axillary incision. March 4, an additional seven centimetres of the third and four centimetres of the second ribs were removed. The total amount of rib resected was one hundred and sixty centimetres. The patient made a good recovery and April 13 was permitted to leave the hospital. The sputum no longer had a fetid odor, had diminished in amount to ten or fifteen cubic centimetres in twenty-four hours and only occasionally contained blood streaks. October 6, the patient returned for observation. Her improvement in general appearance was most striking. She had gained ten pounds in weight, was able to be about and do part of her housework, which she had not been able to do for three years, and stated that she expectorated only in the mornings except when she had an acute cold. Her sputum had contained blood on three occasions only since her discharge from the hospital. Pneumonographic studies made at this time showed marked diminution in the size of the cavities. (Fig. 2.) The speaker said that surgery in the treatment of bronchiectasis, which involves more than one lobe, even if it be limited to one side, can at most be only palliative. Yet the amelioration of symptoms following surgical collapse of the affected side, as reported by Hedblom and others, would seem to justify its employment.

FIG. 1.—Röntgenogram made after bronchoscopic instillation of iodized oil, showing extensive bronchiectasis and pulmonary fibrosis involving the left lower lobe and a portion of the upper lobe. (Report on Röntgen-ray by Dr. W. F. Manges.)

Dr. Louis H. Clerf said this patient had been an invalid for a number of years, and was constantly in dread of pulmonary hemorrhage. Bronchoscopic treatment was instituted and was followed by definite improvement. Realizing that bronchoscopy has definite limitations in these cases in so far that pus will reaccumulate following aspiration, if nothing is done to remove the diseased area, the speaker believed that the surgeon should be given an opportunity to consider the advisability of surgical interference. Doctor Flick saw the patient and thought that much could be gained by operation. The improvement which resulted was remarkable. From the standpoint of the bronchoscopist, one outstanding feature is the aid which can be given to the surgeon; often after a course of bronchoscopic treatments the patient improves to such an extent that he is in better physical condition to be operated upon. The bronchoscopist can also be of great assistance in locating bronchiectatic cavities; no one, not excepting the röntgenologist, had an idea the cavity in the left chest was as large as the pneumonograms showed. By the bronchoscopic instillation of iodized oil it was possible to give the surgeon information as to what had been accomplished and the last pneumonographic studies made October 8, showed a marked contrast when compared with the original studies.

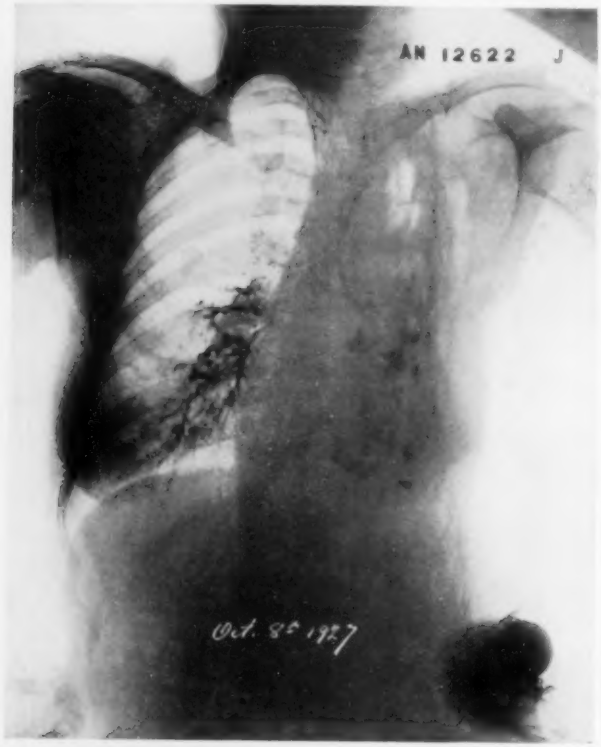

Fig. 2.—Röntgenogram made after bronchoscopic instillation of iodized oil, shows diminution in size of bronchiectatic cavities, following extrapleural thoracoplasty. (Report on Röntgen-ray by Dr. W. F. Manges.)

ABDOMINAL INCISIONS, THEIR MAKING AND CLOSURE

Dr. Irvine M. Boykin read a paper with the above title, for which see page 74.

Dr. A. P. C. Ashhurst said, that he wished to discuss especially two points in Doctor Boykin's paper: first, the exposure which one can secure by the incisions described; and second, the complication of the wound breaking open.

As all know, the linea alba and the linea semilunaris are the two resistant structures in the abdominal wall: if one cuts across one or both of them, one can get a great deal more exposure through a small incision than if one cuts between them. The gall-bladder incision Doctor Boykin describes is better than a transverse incision, because it affords an exposure high up in the midline, as well as sufficient exposure of the fundus of the gall-bladder. Professor Terrier long ago pointed out that biliary surgery tended to become more and more *canaliculaire;* and it is because one cannot get sufficient exposure of the ducts through the longitudinal portion of an upper rectus incision, that Mayo-Robson added the extension of such an incision upward to the ensiform below the costal border. For a time Doctor Ashhurst had used Mayo-Robson's incision; but very soon a patient returned complaining of a large bulge caused by paralysis of the rectus muscle between the incision and the midline. The patient wanted to know what could be done for him, and Doctor Ashhurst had told him "nothing"; because it would be next to impossible to find and to suture all the nerves that had been cut. About that time an article on abdominal incisions, written in 1908 by a Doctor Collins, a gynecologist, of Peoria, Ill., had come to Doctor Ashhurst's attention; and this incision for gall-bladder operations which Doctor Ashhurst has used for many years is the same as that described by Collins, only longer. By cutting the linea alba at the upper end, and (when necessary, also) the linea semilunaris at the lower end, the two most resistant structures in the abdominal wall are cut, giving admirable exposure of the bile-ducts.

Concerning Doctor Boykin's remarks about the draining of appendix incisions, Doctor Ashhurst was not convinced that one gets fewer hernias if the drain is placed at the linea semilunaris rather than at the outer end of the incision, where one has the entire thickness of the transversalis and internal oblique muscles, as well as the muscular fibres of the external oblique; because a drained incision is often long enough to involve some of the muscle fibres of the external oblique. The speaker makes a practice of placing the drain at the outer end of the incision. Doctor Crossan had called Doctor Ashhurst's attention to an observation by the late Dr. James E. Thompson, of Galveston, to the effect that while many of the transverse incisions seem to have hernias at the end of six months or a year, in one or two years more the hernia has disappeared and the wound is firm.

As to the question of wounds breaking open again, Doctor Ashhurst said that a few years ago he had been asked by a surgeon from another city how many abdominal wounds he had had that broke open after operation. Doctor Ashhurst had replied *one*. "Do you mean to say," replied Doctor X, "that in your *entire* experience you have had only one wound break open?" To which Doctor Ashhurst had replied he thought one was enough. Doctor Ashhurst had then inquired from his friend, who seemed to be troubled so often by his incisions breaking open, what was the method he used in closing his abdominal incisions. "In layers, and with mass sutures of non-absorbable material, such as silkworm gut," was the reply. To Doctor

Ashhurst's query whether Doctor X ever closed his wounds with nothing but through-and-through sutures of silkworm gut, the reply was a hesitating "yes", with the explanation that this method was not popular with Doctor X because he had several times had loops of bowel prolapse and become strangulated between these sutures, not so far out as to reach the skin, but at least through the peritoneal surface of the wound. Then Doctor Ashhurst had suggested that perhaps the through-and-through sutures had not been placed closely enough, since in his own experience such an accident had never occurred. Doctor X replied that in an incision about 15 cm. long, he was in the habit of inserting two or three such through-and-through sutures. Now this, Doctor Ashhurst believed, was the explanation of the apparent frequency with which Doctor X's wounds, even when closed in layers, had broken open. Doctor Ashhurst was convinced that if only through-and-through sutures were used, they should be placed not more than 1 cm. apart; and when the wound was closed in layers, the splint sutures should be not more than 2 cm. apart. Moreover, it was very important not to remove either the splint sutures or the through-and-through sutures too early: the former seldom in less than ten days, and the latter scarcely ever in less than two weeks after operation.

On carefully searching his records, Doctor Ashhurst had found a second patient in whom this accident occurred, but it was not an incision in the epigastrium, where most of such disasters have occurred in the experience of others, but a long left paramedian incision, made for purposes of complete exploration and which had been closed in layers and with six splint sutures; moreover, in this case the interne by inadvertence had removed the splint sutures on the eighth day after operation. In the other case, where an incision 15 cm. long (for gastrojejunostomy) had been closed in layers and with five splint sutures of silkworm gut, the wound broke open on the fourth day after operation, and the transverse colon protruded: the two silkworm gut splint sutures at the middle of the wound had broken, but the lowermost and the two upper splint sutures had held. The wounds of both these patients were re-sutured under gas anæsthesia, with nothing but through-and-through sutures of silkworm gut placed 1 cm. apart. Both patients made an uneventful recovery: the first patient, a man sixty-one years of age, developed an incisional hernia, partly because he rapidly gained 40 pounds in weight after operation; the second has a firm incision without any tendency to hernia. Both patients have been followed for six years after operation.

Dr. George P. Muller said that for many years he used the right rectus incision in the lower abdomen and believed this to be the usual practice among Philadelphia surgeons. Of late years the speaker has used the paramedial incision. His reason for preferring this to the right rectus incision being that in the former, one did not encounter the deep epigastric vessels. The speaker still uses the right rectus incision in the upper abdomen, particularly in gastric work, and finds that if the wound is carefully closed and

rigid asepsis is maintained, hernia does not often occur. In gall-bladder work Doctor Muller uses the incision described by Doctor Boykin and has found it satisfactory. In all acute cases of appendicitis the speaker uses the McBurney incision; this differs very little from the Davis incision except as regards the direction of the skin incision. The successful healing of wounds depends on the prevention of infection, the elimination of rough handling and a neat, accurate approximation of tissues without tension. The only cases in which the speaker has had wounds break open are in extensive exploratory operations, for cancer of the stomach where closure has been difficult, due to strain. Surgeons are apt to concentrate their interest in the main features of an operation and have the work undone by the condition of the wound.

DR. I. M. BOYKIN said that his sutures embrace all structures down to the posterior sheath of the rectus and are placed two and one-half cm. apart. He thought that Doctor Muller was mistaken in saying that the McBurney and Davis incisions are the same except for the skin incision. He will find in the follow-up clinic that in the McBurney incisions, that had to be extended, there is permanent damage done to the abdominal wall. This is not true of the transverse incision.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held October 12, 1927

The President, Dr. Frank S. Mathews, in the Chair

MULTIPLE LYMPH-HÆMANGIOMATA

Dr. Otto C. Pickhardt presented a boy who, at five years of age, was first seen June 7, 1922, when he gave a history of several soft swellings around the right elbow and forearm. The smallest one, on the ulnar aspect, a short distance above the wrist, had apparently been present since birth. The largest one on the median and posterior aspect of the right elbow-joint about the size of a small lemon, first appeared at the age of one year and had been gradually increasing in size. A third swelling one inch in diameter, midway between the other two, had suddenly appeared four days previous and was rather rapidly increasing in size. Just above the elbow was a firmer swelling which increased and decreased in size. These swellings bled readily and the boy's arm, his mother stated, was a constant mass of black and blue spots. She had not noticed any similar swellings in other places on the body.

Physical examination showed a perfectly normal boy, except for a phymosis, with the exception of the swellings on the right forearm. These were soft, fluctuating masses definitely intra- and subcutaneous, were freely movable, and not attached to the muscle or bone. They were pale in color and in spots showed ecchymosis. The firm, movable mass above the ante-cubital fossa was evidently a lymph-node. Diagnosis of lymphangioma was made and the parents advised that these tumors were not dangerous and might spontaneously disappear and that re-occurrences were liable to occur at any place and at any time. They stated that because of the constant hemorrhages of the tumors at the slightest trauma, they wished them excised. The boy was admitted to the Lenox Hill Hospital on June 21, 1922, for further study. His blood count showed red blood-cells 5,100,000, hæmoglobin 85 per cent., white blood-cells 5200, polymorphonuclears 48 per cent., lymphocytes 52 per cent. His blood grouping was 1, and his coagulation time was slightly reduced. Operation June 22, 1922, at which time all of the tumors were removed. They were found to be cysts containing numerous daughter cysts, and contained clear, yellow fluid. Numerous large veins were seen entering the cyst wall. They were not encapsulated. The pathological report was lymph-hæmangioma, and the microscopical examination was as follows: "Specimens show an areolar tissue in which there are broad bands of connective tissue. In the septa of connective tissue there are irregular spaces of varying size, some small, some larger, lined by a single layer of endothelium and either empty or filled with lymph or red blood-cells. In the septa which carry these sinuses the blood-vessels are very markedly thickened chiefly in the intima. This thickening has progressed in some instances to obliteration and suggests that the tissue has at some previous time been treated either with radiation or some other physical agent such as diathermy or carbonic acid snow. There is no evidence of malignancy or of tuber-

culosis." The post-operative course was normal, the wounds healing by primary union. June 29, 1922, a circumcision was performed and this also healed without trouble. Discharged from hospital, July 2, 1922, after a stay of ten days.

Post-operative course: July 18, 1922. All wounds firmly healed. A small, red mass has appeared in the right ante-cubital fossa and another soft one on the outer end of scar over the olecranon.

December 21, 1922, the above-mentioned swellings have disappeared. Another one has appeared just posterior to the scar on the ulnar side of forearm. There are also two more small pea-sized soft swellings, one on the anterior and one on the posterior skin of the circumcision scar.

July 10 (one year post-operative), 1923, all swellings on arm and forearm have disappeared, as well as the two on the circumcision scar. These, the mother states, gradually became smaller and finally disappeared.

July 24, 1924, the boy has been growing normally and is perfectly well. All four scars are well healed and firm, and there has been no evidence of any recurrence of the swellings. The circumcision scar is perfect. September 19, 1927, all scars firm and no recurrence on any part of the body has appeared. The case is interesting from the standpoint of the sudden appearance and final disappearance of these lymph tumors, particularly those occurring in the circumcision scar. It is now five years and four months since operation and four years and four months since the last tumor disappeared.

LUNG ABSCESS FOLLOWING PNEUMOCOCCUS SEPTICÆMIA

DR. OTTO C. PICKHARDT presented a girl who at six years of age was admitted to the Lenox Hill Hospital, May 27, 1924. Chief complaint: Pain in the abdomen, especially in right lower side, vomiting, fever, and general malaise; has not felt well for the past two weeks. Physical examination showed an acutely ill child with rapid shallow respirations. Abdomen held rigidly throughout, especially over the right lower quadrant. Rebound tenderness marked throughout. Rectal examination showed pronounced tenderness but no masses. Lungs entirely clear and negative. Temperature 102.8, pulse 152, respirations 42, white blood-cells 29,850, polymorphonuclears 91 per cent. Diagnosis: Acute, suppurative appendicitis.

Operation.—May 27, 1924. Cream-colored, odorless, thin pus, free in peritoneal cavity. Appendix reddened and congested externally, but not swollen or perforated and did not impress one as being the cause of the peritonitis. The right tube reddened and congested, but no pus could be squeezed from the fimbriated extremity. Appendix removed and cigarette drain inserted.

Post-operative Diagnosis.—General peritonitis, probably of pneumococcus origin. This was found to be correct on examination of the culture taken from the peritoneal pus. Post-operative course very precarious; frequent hypodermoclysis and stimulants given. Röntgenographic chest examination May 31, 1924, revealed no pathology. Blood culture shows pneumococci. Röntgenogram of the chest June 4, 1924, shows left chest dense from the level of the second rib posterior to the diaphragm, suggesting fluid from consolidation. June 11, 1924, general condition improved and further röntgenograms show marked improvement at the left base but still some increased denseness present. Abscesses had formed on the site of the hypodermoclysis and on a finger, and cultures from these again showed pneumococci. August 8, 1924, general condition very much better; still running slight fever and the signs on the left base persist

both upon physical examination and from röntgenograms. Blood count normal. Patient sent to a convalescent home in the country, where she continued to gain slightly, but on October 3, 1924, she was re-admitted to the hospital with cough, fever, anorexia, and languor. At this time she presented the same physical findings as at the time of discharge. These were a small area of dulness in the left inter-scapular area near the angle of the scapula where there was diminished voice and breath transmission, slight bronchial difficulty, and a few clicking râles extending upward to the spine of the scapula and anteriorly blending into the area of the pericardium. Slight irregular pyrexia, considerable non-productive coughing and no fetid breath. She had remained well nourished and was not acutely ill. The most outstanding development was a rapid extreme clubbing of all fingers and toes and suggested chronic pulmonary osteo-arthropathy. Bronchoscopy by Doctor Kernan showed no pathology of the bronchi and no evidence of bronchiectasis. Repeated exploratory thoracentesis over the pathological area in the left lung was also negative until November 12, 1924, a needle introduced into the fifth interspace in the anterior axillary line corresponding to a point with left arm on top of head one inch anteriorly and on a level with lower angle of scapula needle inserted slightly upward and inward and backward for a distance of 5 cm., a few c.c.'s of thick gelatinous greenish-yellow pus, odorless, was obtained. It could be plainly seen that the needle moved not only with respiration but also with pulsation of the heart. Fluoroscopy with needle in place showed abscess to have been entered at lower level. Stereo-röntgenograms taken with needle *in situ*. Bacteriologic examination showed again pneumococci. November 19, 1924. Thoracotomy with rib resection and lung exploration under ½ per cent. novocaine. Three inches of sixth and seventh ribs resected in axillary line. Pleura appeared thick and no moving lung could be noted beneath it. Needle encountered thick, heavy tissue but no actual pus was obtained. Three inches of the fifth rib then resected and the lung entered with the actual cautery. The lung tissue was hard, not actually fibrous, but consolidated and atalectatic. During this whole procedure the patient did not cough or expectorate any bloody fluid, showing conclusively that the pathology was in the lung and not in the bronchi. Further explorations continued until the pericardium was encountered, but no pus found; the wound packed with iodoform gauze. Röntgenograms showed that the actual abscess itself was lower than where the exploration had been done. Second operation November 26, 1924, incision and drainage of lung abscess. No anæsthesia. On removal of tampons inserted at first operation the lung cavity made at time of first operation had retracted and enlarged. There were several easily visible bronchial openings through which air passed freely, showing that this portion of the lung which had been consolidated from compression and in which there had been no evidence of bronchial fistula had now become relieved of pressure and was allowing air to circulate through it. With the actual cautery a cavity 5 x 3 x 3 cm. was entered under the seventh rib in the axillary space. This contained thick, gelatinous pus with fibrin. The cavity was found to be divided into two halves by a shelf of lung tissue. In order to obtain better drainage, this shelf was removed and iodoform tampons introduced. Again the pus was found to be of pneumococcus origin and peculiarly enough the shelf of lung tissue removed was found to be tuberculous. The post-operative course was uneventful and three months later, February 17, 1925, the wound with the bronchial fistula had closed. Röntgenograms at that time and later showed no further pathology in the lung tissue and no evidence of consolidation from tuberculosis or abscess. The child was

referred to a convalescent home and immediately gained weight and became perfectly normal. She is now still perfectly well. The points of interest are the ubiquity of the pneumococci and the fact that a true pneumococcus pus in the lung itself if not secondly contaminated did not cause acute symptoms, and thirdly, that a localized lung pathology frequently means abscess and demands surgical intervention.

CONCOMITANT GASTRIC AND DUODENAL ULCERS TWO AND ONE-HALF YEARS POST-OPERATIVE

Dr. Otto C. Pickhardt presented a woman, age fifty-eight years; single. Admitted to the Lenox Hill Hospital, January 31, 1925. *History.*—Sailed from Germany December 31, 1924, feeling well. Had usual seasickness with loss of appetite and vomiting. Seven days before admission sudden sharp cramp-like pains in right upper quadrant. No radiation. Anorexia. No vomiting. *Past History.*—Thirty years ago in bed two days with abdominal cramps. Two years ago sharp pains in right upper quadrant. Loss of weight; ten pounds in two months. Has always taken care of her diet because sour foods caused vomiting. *Physical examination.*—In right upper quadrant distinct tender mass two inches below costal margin and one inch to the right of umbilicus, smooth, firm, and fixed. Temperature 100 to 101, pulse 80. Test-meal showed slight increase of acid. Blood count normal. Wassermann negative. Blood chemistry normal Feces—trace of blood. Röntgenograms showed (1) penetrating ulcer of lesser curvature in middle third; (2) annular growth of pylorus and obstruction; (3) deformity to pylorus suggesting scarring and ulceration. No evidence of vigorous peristalsis. Marked six-hour retention to twenty-four hours. *Diagnosis.*—Lay between multiple ulcers and malignancy.

At operation, February 19, 1924, there were found four ulcers—two in the stomach and two in the duodenum, as follows: (1) On the anterior surface of the duodenum just distal to the pyloric vein, was a freshly perforated ulcer which had attached itself to the peritoneum opposite and to the right of the umbilicus, causing the stomach to be twisted upon itself. There was very little induration around the ulcer but a great deal of redness and inflammation and fresh new adhesions. (2) On the posterior aspect of the duodenum at the junction of the first and second parts and comprising almost the whole of the portion posteriorly, there was a large, soft, and lightly indurated mass which showed through an area of redness and scarring when the duodenum was turned. The duodenum was greatly increased in diameter, being about two and one-half times its normal size. (3) At the lesser curvature, about midway between the pylorus and the cardia, was a large soft mass also situated at the posterior aspect of the stomach about one by two inches in diameter. No crater could be felt, but there was visible some puckering of the gastro-serosa posteriorly; it was not attached to the pancreas. (4) On the anterior surface of the stomach midway between the lesser and greater curvatures, there was a small healed area with very little induration, and it was attached by long, old adhesions to the gastro-splenic ligaments. The cardiac portion of the stomach was normal. In view of the extensive findings of the evident pyloric obstruction and of the extent of the ulcer on the lesser curvature, it was decided that resection of the stomach was neither indicated nor feasible, but that a posterior gastro-enterostomy was for the best interests of the patient. This was done in the usual manner, using Roosevelt clamps, silk for the sero-serous suture, and fine chromic for the internal sutures. The gall-bladder appeared normal and the foramen of Winslow was patent. At the close of the operation the omentum was

distributed partially over the buried ulcers. Post-operative course normal until the eighth day. At that time patient began to vomit dark foul material, in which was found a large Ascaris lumbricoides worm. This continued for three days, the vomitus becoming more bile filled. Apparently a middle vicious circle was present, but this cleared up under lavage. Patient left the hospital, April 20, 1925, feeling perfectly well and having gained twelve pounds in weight. A röntgenogram taken just before discharge showed the barium meal passing out through both the pylorus and the stoma. There is seen a pouching on the greater curvature producing a sacculation, and there is still considerable dilatation in the third portion of the duodenum. The stomach completely emptied in six hours. A follow-up röntgenogram, February 18, 1926, showed the gastro-enterological stoma to be working in a normal manner. The stomach empties completely within four hours. There is evidence of retention of the barium in what apparently is the ampulla of Vater. This disappeared completely in six hours. The patient is now still perfectly well and is doing regular housework. She is only moderately careful of her diet and weighs 133 pounds. She has a good appetite, no heartburn or nausea, and has taken no medicine of any kind since then. She states that she does not know she has a stomach.

STRANGULATED UMBILICAL HERNIA WITH GANGRENE OF TRANSVERSE COLON

Dr. Morris K. Smith presented an elderly woman who was admitted to St. Luke's Hospital, May 31, 1927, with the diagnosis of strangulated umbilical hernia. For twelve years she had had a large hernia. It had always been reducible until 1 P.M. of the day of admission, at which time it came down and could not be replaced. She had vomited once and been in pain. Examination revealed a woman of seventy-two, acutely ill, although not prostrated. Just above the umbilicus the hernia presented as an irreducible rounded hard mass the size of a large fist. The skin over it was reddened. Operation was done under local anæsthesia seven hours after onset of strangulation. On opening the sac there came into view eight inches of gangrenous transverse colon. On account of the patient's age and condition it seemed as if primary resection would be quite hazardous, so a first-stage Mikulicz was done. The spur was opened the next day and three days later cut away. The clamp had to be applied twice before the loops were cut through sufficiently deeply. Two months after the first operation the fistula was closed operatively. There was almost no fecal drainage after this and the wound healed satisfactorily.

At no time did the patient seem critically ill. For the first two to three weeks she had a moderate amount of fever due to suppuration in the wound. After this the general condition improved steadily.

This case is presented not as showing anything new, but as illustrating the application of this relatively safe method of resection of the colon in strangulated hernia in an elderly patient. It is not the method of choice either from the standpoint of cure of the hernia or rapidity of recovery. From the standpoint of saving life it seems a desirable method in similar cases.

Doctor Smith said he had been very much surprised to find the gangrenous loop, considering the short history, and believed it possible the strangulation had begun earlier than reported. The woman's son had always previously been able to reduce it and he had made a thorough trial to again

accomplish this before the mother was taken to the hospital. The ring was very tight and the gut so black that there was no question of the non-viability.

RECURRENT DISLOCATION OF THE SHOULDER

DR. MORRIS K. SMITH, referring to an article by Dr. Melvin S. Henderson, entitled "Tenosuspension for Habitual Dislocation of the Shoulder," which appeared in *Surgery, Gynecology and Obstetrics* for July, 1926, presented two cases of recurrent dislocation of the shoulder.

CASE I.—A man, age twenty-three, was admitted to St. Luke's Hospital, August 6, 1926. Two years previously he dove into shallow water with arms outstretched and dislocated the left shoulder. Since then it has dislocated five more times, the last two weeks before admission.

Operation.—Curved incision with convexity downward over upper end of humerus and acromion process. Horizontal drill holes were made through the end of the acromion and the greater tuberosity of the humerus, the latter being approached through vertical incisions in the deltoid. A strip of fascia lata was next removed from the thigh, brought through the drill holes, and the ends sutured together with silk, thus providing a check ligament to dislocation of the humeral head. The fascial strip was reinforced by a loop of braided silk and the wound closed.

The arm was at first bandaged to the side. The patient was discharged on the tenth day and instructed not to abduct to a right angle inside of three months. Thirteen months later he reported that he had had no more dislocations and has good use of the arm. He has played baseball. Examination shows slight limitation of abduction, otherwise motion free.

CASE II.—A man, aged twenty-three, was admitted to St. Luke's Hospital, August 21, 1926. Three years before he dislocated the right shoulder in a fall from a horse. Since then the dislocation has recurred five times from minor injuries, the last time six weeks previous to admission.

Operative procedure the same as in Case I except that the reinforcement of braided silk was not used. This patient was also discharged on the tenth day with instruction not to abduct arm for three months. He was if anything overcautious in resuming movements. He has had no further dislocations and is now doing manual work on a railroad. Motion is excellent.

DOCTOR SMITH said that in the operative procedure he attempted to follow Henderson's technic except that he used fascia lata instead of the tendon of the peroneus longus. In his article he reported three cures by tenosuspension, the longest follow-up being 22 months, with no recurrences. As contrasted with this there were at the Mayo Clinic 19 follow-ups (over a longer time it is true) on capsulorrhaphies with 42 per cent. cured and 32 per cent. decidedly improved and 8 Clairmonts (muscle sling plastic) with 63 per cent. cures.

Dr. Carl Beck, of New York, presented a case of recurrent dislocation before the Surgical Section of the Academy of Medicine in December, 1902, and reported it in the *New York Medical Journal* for July 11, 1903 (referred to by Henderson) in which he had done at the same time a capsulorrhaphy and passed a silver wire through drill holes in the head of the humerus and acromion. He removed the wire in six weeks. The result at the end of six months he described as perfect.

Dr. Albert E. Sellenings referred to a case in which the patient had received injury to his shoulder by a fall from a ladder and after that he dislocated it repeatedly, as many as fourteen times. A modified Thomas capsulorrhaphy with crucial suture was done. After four months the man was able to engage in all sorts of activities, including swimming, and has since remained well. The operation was performed two years ago.

Dr. Constantine J. MacGuire, Jr., referred to a case in which he had used braided silk for suturing the acromial end of the clavicle to the coracoid process in dislocation of the outer end of the clavicle, in which case a fistula formed six months later, requiring removal of the braided silk, which had worked completely through the clavicle. He felt that it was possible that the same situation might result in the use of braided silk in Doctor Smith's case.

Dr. John M. Hanford said that he had done the Kellar operation in one patient with recurrent dislocation and the technic had been apparently satisfactorily accomplished. The patient was seen about two months ago and stated that a recurrence had occurred while swimming about a year after the operation.

Doctor Smith, in closing the discussion, said that he had recently read an article by Carrel who described a recurrence after the teno-suspension operation. The speaker did not believe that any method whatever would give 100 per cent. cures. He believed the prolonged immobilization of the arm to be an important part of the treatment. The teno-suspension method appealed to him because of its simplicity and the avoidance of risk of traumatism to important structures. As to Doctor MacGuire's prophesy, it did not seem likely that the braided silk would cut through the acromion in this case as there was no tension on it such as was necessary in Doctor MacGuire's case.

ACUTE HEPATIC DEGENERATION—CHOLECYSTOGASTROSTOMY

Dr. Charles Gordon Heyd presented a young man, twenty years of age, who entered the New York Post-Graduate Hospital, October 6, 1926, complaining of jaundice, nausea and vomiting; weakness; mental depression and with a loss of twenty pounds in weight during the preceding six weeks. The patient's present illness began about two months ago with fever and weakness. Patient states that he ran fever for three days and at about the same time began to lose strength and weight and was frequently nauseated at this time. About two weeks after the onset of fever the patient became jaundiced which increased in intensity for three weeks and then faded away. After an interval of a few days in which the jaundice was distinctly diminished, there was an increase in the intensity of the jaundice, with fever and vomiting becoming more frequent. There was no pain, although there was considerable belching and eructation of gas. Patient states that his stools were gray in color but otherwise not noteworthy. Patient had a mastoid operation, a septum operation, and adenoids and tonsils removed some eleven years ago. When he was admitted to the hospital he was intensely jaundiced with marked itching and no petechiæ. Physical examination was negative except for tenderness in the right upper quadrant, a palpable liver and pal-

pable spleen. The tentative diagnosis was obstructive jaundice—possibly of toxic origin. The leucocyte count was 11,800; 74 per cent. polynuclearphils; red cells 4,952,000 per cubic mm.; hæmoglobin 96 per cent.; platelets 224,600 per cubic mm.; Wassermann was negative; the icteric index was 100, Van den Bergh direct +, Van den Bergh indirect +++: Fouchet +++. October 17, the icteric index was 166.6, Van den Bergh, direct ++++, Van den Bergh, indirect ++++, Fouchet ++++.

X-ray examination of the gall-bladder region revealed no evidence of calculi. The right lobe of the liver was markedly enlarged but its free border quite smooth. X-ray examination of the kidneys was negative. X-ray examination of the gastro-intestinal tract was negative except at the end of twenty-four hours there was considerable irregular distribution of the barium meal suggesting irregularities of colonic spasm with a stasis of material in an irregularly filled segmented appendix. The stools were uniformly clay colored but did give a trace of bile.

The patient's progress was continuously worse, jaundice increased in intensity, mental depression and pruritis were exaggerated. Vomiting became a prominent feature for ten days previous to operation. At operation, October 20, 1926, the liver was found to be about twice the size for the patient's age, weight and stature. There was no evidence of fibrosis of the capsule of Glisson. There was about 300 c.c. of pale ambre ascitic fluid in the abdomen. The gall-bladder was thickened, without stones; increased thickness of the gall-bladder wall was apparently due to œdema. The common duct was narrow, not thickened nor dilated. The lymph-glands at the junction of the cystic and common duct were enlarged. The pancreas, if anything, was softer than usual. The gastro-duodenal segment was negative. The lower abdomen was not explored: the appendix was left *in situ*. Operation consisted of a cholecystogastrostomy with the application of the gall-bladder to the lesser curvature of the stomach about three cm. from pyloric ring. Suture line was reinforced by wrapping a portion of the greater omentum about it and a small cigarette drain was inserted into Morrison's space. Aside from nausea which lasted for six days the post-operative convalescence was uneventful. Seven days after operation the icteric index dropped to 101, while the Van den Bergh direct and indirect were still ++++ and Fouchet ++++. Two weeks after operation the icteric index was 65, Van den Bergh direct and indirect +++, Fouchet +++. From this time on the patient had a constantly diminishing jaundice and was discharged on the twenty-sixth day after operation with normal colored stools and practically free from jaundice, although the sclera were suggestively yellow.

This patient presented a condition characterized by an intense progressive jaundice that was sequential or associated with a febrile attack. The clinical and chemical evidence was such as to suggest complete biliary obstruction. The feeling of his attending physician was that this patient had had an initial attack of influenza. The stools in the beginning were bile colored but later became clay colored with practically an entire absence of bile. This is the third case of this type that we have had in the last three years and in none of them has the gall-bladder been palpable nor has there been any suggestion as to the applicability of Courvoisier's law. X-ray studies did not reveal any gall-bladder disease. The liver on laparotomy has been smooth and glistening and nearly of normal color, but of about twice the normal size. There was no evidence of interstitial fibrosis such as is observed in long-continued abdominal affections and gall-bladder disease. The gall-bladder itself was œdematous and hypervascularized but did not contain bile but colorless mucoid material. Cystic and common ducts were not obstructed

although œdematous. It would seem that the underlying pathology in this patient was that of an infectious or toxic condition with degeneration of the hepatic parenchyma. As a result of the destruction of the liver cells the bile canaliculi become blocked with broken-down cellular detritus and bile thrombi. The cytolysis of liver cells continues with a collection of bile into so-called "lakes", thus there are two pathological factors at play, (1) the primary destructive action as the result of a hæmatogenous process and (2) the mechanical feature with obstruction of the small bile canaliculi. The final result so far as the liver is concerned is the development of a marked and gross œdema of the entire liver. A condition well described as a hydrohepatosis. These changes may be followed in the histological examination of specimens of liver removed at the time of operation.

The question arises of what benefit was a cholecystogastrostomy. It would appear that the surgical indication in this case was to deplete the liver tissue of its fluid, in other words, to relieve the passive congestion and œdema. This could be accomplished by multiple incisions in the liver, but the effect of hemorrhage would prohibit this procedure. The only other way of producing a loss of fluids and relieving the œdema factor was to devise an adventitious means of lymphatic drainage. This could either be accomplished by a cholecystostomy or a cholecystogastrostomy. In the former there would be the loss of bile, not to be lightly considered, and in the latter there would be established a lymphatic depletion of the liver with delivery of bile into the gastro-intestinal tract. This was the reasoning that prompted us to do a cholecystogastrostomy in the presence of an obstructive jaundice that was apparently within the liver and in the presence of normal gall-bladder and biliary passages.

Case II.—Doctor Heyd also presented a woman who had appeared before the New York Surgical Society in April, 1926, and was reported in the Annals of Surgery for November, 1926. This patient had had a cholecystogastrostomy performed for what was tentatively assumed to be an acute catarrhal jaundice. The small portion of the gall-bladder removed in making the cholecystogastrostomy ostium on histological examination showed no evidence of any pathological change. The pathological report on the liver tissue showed the lobular structure was easily recognizable. The Glisson's capsule was thin and several lobules near this surface as well as in the deeper areas showed changes within the centre of the lobules. The changes were characterized by the disappearance of liver cells to such an extent that the centre of the lobules showed only the framework without liver cells. In these areas of the liver lobules there was a proliferation of the endothelial cells and numerous lymphocytes and occasional polymorphonuclear leucocytes were to be seen. The liver cells, particularly near the centres, which were preserved, showed parenchymatous degeneration occasionally with karyolysis. There was only a small amount of bile pigment recognizable in the cells. The picture was that of a central necrosis of the liver lobules. It could be compared to the changes of acute yellow atrophy, only it was of a much milder degree. Doctor Heyd presented this patient as evidencing a remarkable recovery from a grave liver injury and as indicating the marked degree of regenerative power possessed by the liver as the patient had given birth to a normal baby on July 30, 1926. She had an uneventful pregnancy and puerperium and had enjoyed good health since the time of her operation.

Dr. Edwin Beer remarked that Doctor Heyd had not mentioned in presenting his cases whether there had been any temperature, or whether

any Lyon's test had been made. He personally has seen a number of these cases which looked like serious cases of catarrhal jaundice clear up when magnesium sulphate was fed through a duodenal tube into the duodenum, no surgical interference being necessary.

It would seem, in view of the fact that, as Doctor Heyd has subsequently stated, no bile was found in the intestines when a Lyon's test was made, and in view of the fact that the patient vomited bile after the gastric anastomosis with the gall-bladder, there had been an obstruction in the peripheral part of the common duct, the exact nature of this obstruction being undecided. A better proof that Doctor Heyd was dealing with such an obstruction would be difficult to find.

Dr. John Douglas referred to Doctor Heyd's apparent contention that so-called catarrhal jaundice is really hepatic degeneration. Most of the cases of catarrhal jaundice get well without operation, but the speaker had seen two patients die within the last year, and it appeared impossible to do anything for them. Therefore, if Doctor Heyd has found a method of curing such cases he has made a valuable contribution to surgery, but Doctor Douglas failed to see the connection between the operation and the cure of the patient, except in point of time. If they have degeneration of the liver cells it is presumably due to some toxin. There is no obstruction to drainage of the big ducts and the obstruction is apparently in the small radicals. As to Doctor Heyd's explanation that there is lymphatic drainage sufficient to relieve the pressure on these small radicles; while it is true that the lymphatics of the liver and gall-bladder communicate, the gall-bladder has few lymphatics and it is difficult to understand how by this anastomosis between the gall-bladder and the stomach sufficient lymphatic drainage can be established in such a short period of time that the patient will drain sufficient bile into the stomach to vomit bile in 24 to 48 hours. Doctor Douglas thought it would be worth while for Doctor Heyd to report more of these cases with results, but the theory of lymphatic drainage to cure a degenerative condition due to toxins did not appeal to the speaker sufficiently for him to attempt to operate for this purpose.

Dr. Allen O. Whipple reported a case which was very similar to the two of Doctor Heyd, the only difference being that nothing but an exploratory operation was done. The patient nevertheless got entirely well. He had no explanation for that. This patient, a woman, had had pernicious anæmia for five to six years and had improved remarkably on a liver diet. She later had been under observation for two months, during which there was deep jaundice elevation of temperature and some tenderness over the liver area. After failure to get bile through with the Lyons test an exploratory was advised and the liver was found to be enlarged. The astonishing part was that the common duct was not distended. The impression was received, through the collapsed appearance of the gall-bladder, that the liver had stopped passing bile into the duct system. Because of lack of evidence of obstruction in the common duct, the wound was closed and nothing

further was done. On the third or fourth day the patient was given glycerin and Vichy and promptly began passing bile, the symptoms cleared up and she has now remained well for a period of eight months.

Doctor Heyd, in closing, stated that the patient presented was admitted to the Post-Graduate Hospital, under the care of Doctor Mosenthal. The preliminary diagnosis was that of chronic jaundice secondary to acute influenza. In spite of the most approved medical therapy, including the Lyons' method, the patient progressively became worse and in the opinion of three consultants was considered hopeless. From their previous experience it was suggested that a cholecystogastrostomy be done irrespective as to the pathological condition that was causing the obstruction. This was carried out and the patient progressed to complete recovery. Doctor Douglas' objection is perfectly valid and in searching for the reason for the cure of this patient they could only assume that the cholecystogastrostomy provided a means for relieving the œdema and congestion of the liver. Previous histological studies of the liver showed the remarkable destruction of liver tissue, with œdema. Surgically, the operator could have relieved the œdema of the liver by making multiple incisions but this would have been absolutely impossible on account of hemorrhage. It is well to recall that the greatest degree of liver enlargement in acute hepatic necrosis is due to the serum that is present in the liver. Experimentally, it has been demonstrated that the removal of an acutely degenerated liver in toto and suspending it as much as 500 to 1000 c.c. of water can be obtained by drainage. In the patient presented to-night the gall-bladder was without bile. No bile was present in the gastro-intestinal tract, yet at the end of forty-eight to seventy-two hours after cholecystogastrostomy bile was present in the stomach. Within ten days the icteric index dropped to 67. This case may be one of opportunism and the patient on the way to recovery irrespective of what was done, but it seemed reasonable that we changed some of the hydrostatic mechanism of the liver and allowed hepatic regeneration to take place.

ACCESSORY PANCREAS SIMULATING GASTRIC ULCER—RESECTION

Dr. Charles Gordon Heyd presented a woman, aged thirty-nine, who entered the Post-Graduate Hospital on November 12, 1926, complaining of flatulency, indigestion and pain in the right upper quadrant. The past history was negative. Physical examination and hospital studies suggested the tentative diagnosis of cholecystitis. The patient was operated upon, November 13, 1926, and the gall-bladder was negative on palpation and inspection. However, on the posterior surface of the pyloric ring and more particularly on the gastric side was a small peñetrating ulcer with marked infiltration and induration. The appendix was found chronically diseased with a few adhesions, angulation and fecoliths. The operation consisted of a gastrotomy and visual inspection of the ulcer which was followed by a resection of the pylorus embracing one cm. of the duodenum and five cm. of the pyloric end of the stomach. By reason of the obesity of the patient it was deemed wise to close both duodenal and gastric stumps and do a posterior gastro-enterostomy. Patient took the anæsthetic badly and the immediate

post-operative course was somewhat stormy with considerable post-operative vomiting, necessitating gastric lavage on two occasions. From the third day after operation the patient, however, made an uneventful recovery and was discharged from the hospital on the seventeenth day after operation.

The interest in this case lies in the pathological report: "The specimen shows typical gastric pyloric glands, at the other end typical duodenal mucosa with Brunner's glands. Between the two the mucosa is thinned, although infiltrated with lymphoid cells and lymph nodules. Beneath this area are lobules of characteristic pancreatic tissue provided with interlobular ducts These lobules of pancreatic tissue extend between the muscle bundles of the pyloric sphincter, in the deeper portions of which the ducts are much more conspicuous than the secretory alveoli. Dilated ducts can be traced into the serosa. In the two sections made through this area no actual communication between ducts and alimentary mucosa can be demonstrated." The pathological diagnosis was that of ulcerating aberrant pancreas, and chronic appendicitis.

ANOMALOUS HEPATIC DUCT—PERICHOLECYSTITIS

Dr. John M. Hanford presented a woman, age twenty-six, who was admitted to the Presbyterian Hospital in August, 1923. She had been ill three days with very severe pain in the right upper quadrant of the abdomen and with radiation of the pain to the back and right shoulder region. She had vomited and had chilliness. She had had frequent similar attacks for five years—that is since she was twenty-one. With one, she had been jaundiced. Morphine alone had given relief. She married at fifteen, and had had three children. She had not had typhoid fever. The past history was otherwise irrelevant.

The temperature and pulse were normal. The respirations were 46, probably due to pain. The urine was normal and showed no bile. The blood count was normal. She was operated upon three days later, under nitrous oxide-oxygen-ether. An upper right rectus incision was made.

There were adhesions between the fundus and body of the gall-bladder and adjacent viscera. In the region of the ampulla and cystic duct, the fibrous tissue was very dense and the structures here could be identified only by sharp dissection. All other viscera were found essentially normal. The appendix was not examined. There were no enlarged lymph-nodes and no evidence of distention of nor calculi in the ducts.

The exposure by chance was good. There appeared to be an unusually large cystic duct embedded in very dense tissue. After working upon it to free it, it was about to be clamped, when a separate structure running vertically in front of the cystic duct was identified. At first, it was thought a vein. After making a small opening into it, a vertebrated probe was passed in it up into the liver and upon the withdrawal of the probe, normal bile emerged. This structure was then accepted as the right hepatic duct running downward, separate from the common duct which it did not join as far as it could be traced behind the duodenum. This duct was about ½ cm. in diameter and had an indurated wall. It ran ½ cm. to the right of the common duct and nearly parallel to it. There were a few calculi in the gall-bladder. The opening was sutured; the cystic-duct freed and clamped; and the gall-bladder removed from duct to fundus.

After a relatively smooth uncomplicated course, she was discharged from the hospital on the eighteenth post-operative day and has shown a satisfactory follow-up result through nearly four years.

This woman owing to a duct anomaly came near to a fatality. After one fatality due to unexplained operative damage to the common duct, the reporter had never ceased to be uneasy working in the region of the ducts.

CALCULOUS OBSTRUCTION OF THE COMMON AND HEPATIC BILE-DUCTS

Dr. Ralph Colp read a paper with the above title, for which see page 890, Annals of Surgery, vol. lxxxvi.

Dr. Allen O. Whipple said he thought it should be emphasized that the statistics given represent a cross-section of a general surgical service because, if one does not take that into consideration, and does not look into his own hospital statistics, one might think the results of operation in common duct obstruction discouraging. Doctor Whipple was sure that in any hospital where the cases are fairly analyzed the mortality in obstruction cases will be as high in proportion to cases in which the disease was limited to the gall-bladder as were those of Doctor Colp. The point to be emphasized is the difference in the mortality and risk of surgery where the disease is limited to the gall-bladder as compared with the disease when it has progressed beyond the gall-bladder into the duct system and the pancreas. In some 400 cases he had operated upon and subsequently followed, Doctor Whipple found there were 279, in which the disease was limited to the gall-bladder, in which there was no evidence of common duct or pancreas involvement. In 90 per cent. of these cholecystectomy was done and there was only one death. In the common duct cases where the disease had passed beyond the gall-bladder, the mortality jumped to 23 per cent. These figures included the cholangitis and the carcinoma cases.

The speaker felt it most important to stress the difference in risk, ease of operation and late results, in cases operated upon for disease limited to the gall-bladder and in those where the process had extended into the ducts and pancreas.

Dr. Richard Lewisohn stated that he agreed with Doctor Colp as to the dangers of general anæsthesia in cases of jaundice. He had performed a number of choledochotomies for common duct stones under local anæsthesia with very satisfactory results. During the last year he had used high spinal anæsthesia in this group of cases. The results were very gratifying.

Dr. Alexis V. Moschcowitz stated that he was in absolute accord with almost every statement made by Doctor Colp. He would take exception, however, to Doctor Colp's condemnation of the procedure of dealing with the common duct without the introduction of a drainage tube directly into it. Many years ago, when surgeons were influenced by Kehr's teaching of the necessity of hepatic drainage, this was also the procedure practised by Doctor Moschcowitz. Subsequently, and at first tentatively, he sutured the incision into the common duct and when he found that these wounds healed very kindly, he adopted the procedure as a routine method.

Dr. Edwin Beer remarked that these studies place the surgeon in a dilemma as regards time of operation. His studies would indicate that the

earlier the operation, the better the results in obstructive jaundice. If this were the case it would lead surgeons to operate shortly after the onset, at a time when the stone may have passed into the duodenum, or perhaps at a time when the whole common duct is full of stones which would be very difficult to remove in such numbers, no matter how careful the surgeon might be.

Doctor Beer also felt that experience shows conclusively that choledochotomy drainage is absolutely essential, because often stones are overlooked, and at times stones are in the intra-hepatic ducts which are washed out during the after-treatment. In a series of such cases studied a few years ago in which the common duct stone had been removed and hepaticus drainage instituted, fragments of stones, gravel and real stones had been recovered in a lavage of the biliary system. This point cannot be overemphasized too much, as in my study of 71 cases of cholelithiasis, 5 showed intra-hepatic stone formation. Practically all the cases of cholelithiasis with common duct obstruction due to stone showed regularly intra-hepatic stone formation. In a recent autopsy report from Russia, intra-hepatic stones were found in 25 per cent. of the post-mortems.

Dr. Frank S. Mathews reported two cases which he thought were probably cases of primary common duct stone formation. Case one had a cholecystectomy twenty years before, was well for nineteen years and then developed common duct symptoms. Six fascetted stones were removed. The second patient was thirty-eight years old. Her gall-bladder had been removed ten years ago and she had remained in good health until late in the course of a pregnancy which recently terminated. Just before and after the labor she had attacks of pain without jaundice. Operation revealed a single mulberry and cholesterin stone. It would seem as though a pregnancy eleven years after operation and the only one since operation had determined the stone formation.

Dr. Ralph Colp, answering Doctor Moschcowitz, stated that Doctor Moschcowitz had done very few of these cases on the ward service and these results were represented mainly by the efforts of the younger men. The conditions of stone in the common bile-duct are not the same as in stone in the ureter, because there are two kidneys, and with the shut down of one, the other functions, and you do not have cessation of all function. With hepatic drainage in all these cases there was leakage in from four to five days, but in the meanwhile the spasm of the sphincter of Oddi had resulted in a damming back of bile with the deleterious effects of increased absorption.

In regard to the point Doctor Beer made about the time of operation. In this series there was only one patient who was thought to have common duct obstruction and at the time of operation the duct was dilated, but the stone was not found.

BRIEF COMMUNICATIONS

ENTEROLITH SUGGESTING VESICAL CALCULUS

We believe the case presented herewith should be reported for the following reasons:

(1) *The similarity of the X-ray shadow of the enterolith to that of a vesical calculus.* Unless one has in mind the possibility of enterolith, an error in diagnosis might easily be made.

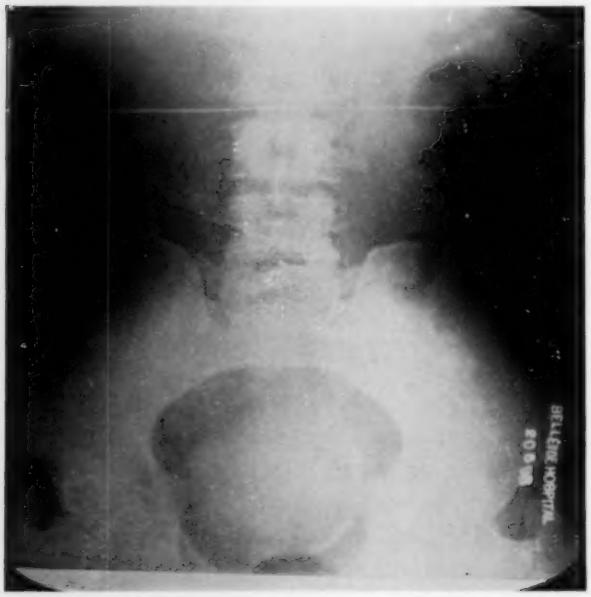

Fig. 1.—Shadow of enterolith. Except for the fact that it is hardly dense enough, it might be mistaken for a vesical calculus shadow.

In 1924, Childs [1] reported a large fecolith located in the rectum. The X-ray plates of his case showed a dense shadow which resembled that of a stone in the bladder.

(2) *The infrequent occurrence of enteroliths.* Gant,[2] in a complete review of the literature in 1901, collected 50 cases to which he added three of his own. We have been able to find only five reported since 1919.

(3) *The unusual size of the specimen.* Most enteroliths are quite small, varying in size from a pea to a walnut. Larger ones are seldom seen. The largest one ever found, according to Winterstein,[3] weighed 1500 grams.

Case Report.—A male, aged twenty-seven, was admitted to the Bellevue Urological Department, August 14, 1926. The outstanding features of his past history were chronic constipation since early youth and an absolute dependence on laxatives to obtain a satisfactory bowel movement.

Two months before admission, he began to have pain of an intermittent type in the left lower quadrant. This pain would disappear after an efficient laxative had been taken. When constipated, there was also pain in the rectum. There were no urinary symptoms.

[1] Childs: Large Fecolith. Radiology, 1924, vol. iii, p. 261.

[2] Gant: Recto-colonic Enteroliths and Concretions. The Post-Graduate, 1901, vol. xvi, p. 335.

[3] Winterstein: Ueber Enterolithen. Deutsch. Zeitsch. f. Chirg., 1925, vol. cxciii, p. 409.

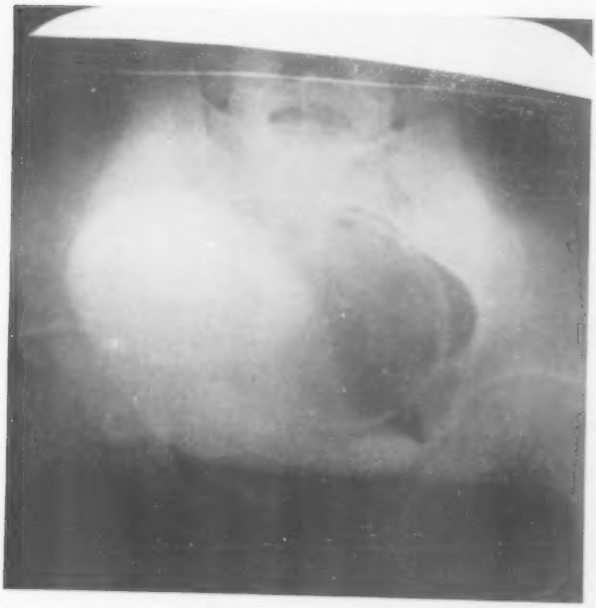

FIG. 2.—Cystogram. The bladder is pushed to one side, while the enterolith shadow remains in the centre of the pelvis.

FIG. 3.—X-ray after barium enema. Note marked dilatation of sigmoid.

Physical examination disclosed in the left lower quadrant of the abdomen a large indistinct mass, insensitive to pressure and somewhat movable. By rectal palpation, there was a globular mass, immediately inside of the sphincter and separated from the examining finger apparently only by the rectal wall. With the other hand above the pubis during rectal palpation, the globular character of the mass could also be determined bimanually, slight ballottement being possible. The prostate gland was apparently normal. Urine analysis: Negative.

The patient was X-rayed. The radiographer reported, "The whole pelvis is occupied by a rounded calcareous mass suggesting vesical calculus." (Fig. 1.)

A cystogram with 6 per cent. sodium iodide was next made. Radiographer's report: "Cystograph examination reveals a moderate-sized viscus displaced to the left; the outline is normal." (Fig. 2.)

FIG. 4.—Photograph of section of enterolith. The scale is in centimetres.

Cystoscopic examination showed a normal bladder mucosa with the left bladder wall inverted as if a large rounded mass were pushing it in from without. A proctoscopic examination of the rectum was negative.

X-ray after the administration of a barium enema showed, according to the radiographer—"marked dilatation of the sigmoid flexure and descending colon"; also "a marked pressure defect in the sigmoid flexure corresponding to the mass previously described. (Fig. 3.)

By virtue of a certain routine examination which many of our cases undergo immediately on admission, the radiographer's report, together with the film (Fig. 1) were submitted to us, before a general physical examination of the patient had been made. The symmetrical position of the shadow with regard to the bony pelvis almost forced upon us the diagnosis of vesical calculus, although the shadow seemed entirely too "thin" for a stone of such size. However, the negative urine, together with the negative cystoscopic findings, soon led us to eliminate the urinary tract. The radiographic results with the barium enema, the cystogram and general physical findings, enabled us to make the correct diagnosis of enterolith. The patient was accordingly transferred to the Second Surgical Division where he was successfully operated upon by Dr. H. M. Bergamini. By means of an intraperitoneal operation, he found the enterolith in the lower portion of the sigmoid. After removing the obstructing mass, the gut was sutured. The peritoneum was drained.

The patient was discharged from the hospital in good condition on the thirty-fifth day after operation.

Gross examination of specimen: Uniform throughout with slight lamellation at the periphery. Many small crystals could be discerned, by their reflection, throughout the mass. (Fig. 4.)

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PRIMARY CARCINOMA OF THE HEPATIC DUCT

Primary carcinoma of the hepatic duct is rare. Rolleston, in a careful search, was able to collect only twenty-two cases, involving this portion of the biliary system. It is because of its comparative rarity that we add this case to surgical literature.

The patient, a white male, age seventy-three, was referred by Dr. Samuel O. Kemp of this city. He complained of a persistent painless deepening jaundice of about four weeks' duration. The past history was not remarkable. There were no gastro-intestinal symptoms and no history of gall-stones. During the previous two or three weeks the patient complained of general weakness, but was not aware of any loss in weight.

Physical examination showed a well-developed elderly man with marked jaundice. The temperature, pulse and respirations were normal.

The lower edge of the liver was palpable about three inches below the costal margin and liver dulness extended to the fourth interspace on the right side. Both the right and left lobes were apparently enlarged. There was no swelling of the lower extremities and no free fluid in the peritoneal cavity.

The urine was dark green in color and gave a positive test for bile pigment; it also contained albumin and casts. The stools were clay-colored and contained many fat globules. The coagulation time of the blood was not increased, ranging from four to five minutes. Blood sugar 88 mg. and N.P.N. 24 mg. The Wassermann reaction was negative.

A provisional diagnosis of carcinoma at the head of the pancreas was made and operation advised. This was subsequently done under local anæsthesia with the following operative findings:

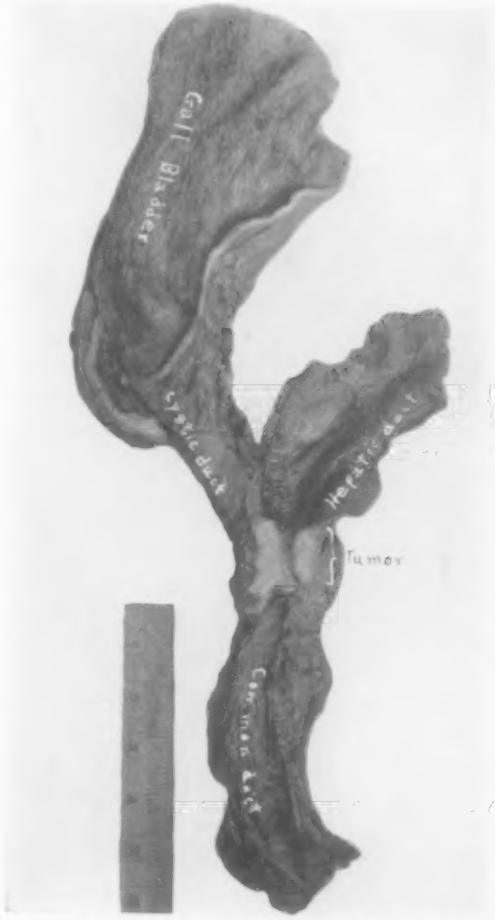

FIG. 1.—Photograph of gall-bladder and bile-ducts showing the tumor in the terminal portion of the hepatic duct.

The liver is diffusely enlarged, extending almost to the umbilicus. The gall-bladder is somewhat distended and empties with difficulty. There is no evidence of gall-stones in the gall-bladder nor cystic duct. The head of the pancreas is not enlarged and there are no palpable portal lymph-nodes. No stones are felt in the common duct but the hepatic duct seems somewhat thickened. On account of the age of the patient and his poor general condition further operative interference was thought to be contra-indicated. The gall-bladder was drained and the wound closed with interrupted silk sutures.

Following this there was scant drainage from the gall-bladder averaging from one to four ounces a day.

On the fourth day after operation the patient developed a broncho-pneumonia with signs of cardiac failure and expired four days later.

We are indebted to Doctors Jacobson and Waddell for the autopsy findings and quote verbatim from their report.

"Liver: weight 2100 gms. It is diffusely enlarged, and the edges are much rounded. The lobules are outlined beneath the capsule by deep green lines about yellowish-brown lobules. On section there is very great dilatation of the intrahepatic bile-ducts which are filled with a pale greenish fluid. The lobules are outplied by greenish lines. As the hepatic ducts are disclosed they become progressively dilated toward the hilum where they emerge as the right and left chief ducts which are fully one cm. in diameter and filled with thin pale green fluid. No stones are found in any of the ducts. See photograph (Fig. 1).

FIG. 2.—Low power photomicrograph of longitudinal section of tumor. Showing invasion of tumor cells still preserving an acinar structure extending to the adventitia and the marked fibrous reaction.

"Opening the hepatic duct discloses a mass of white tissue, firm, and which does not move on manipulation, which appears to obstruct completely the lower end of the hepatic duct. This growth is about 2 x 1.2 x 1.5 cm. in size and a probe can be passed through it with great difficulty. It has a finely nodular surface and springs rather abruptly from the duct lining. It extends to involve a few millimetres of the upper end of the common duct also.

"The cystic duct opens just below the growth, but it is doubtful if its ostium was functionally open, as it is in such close proximity to the tumor. The common duct is very slightly dilated also, but there are no stones to be found. The ampulla is of slightly increased prominence but otherwise normal.

"The gall-bladder has been opened at its tip for surgical drainage. Its walls are thickened moderately, mucosa pale and reddened. No stones present. At operation it is said it was distended with pale colorless fluid. The cystic duct is not dilated."

"The tumor is an adenocarcinoma of the hepatic duct, apparently arising in its mucosa, growing upward to obstruct the lumen and downward to cause much thickening of wall. It has penetrated to the fatty tissues about it which it has also invaded. The tumor has produced considerable reaction in stroma where there is a fairly abundant connective tissue."

Attention is called to the marked dilatation of the duct system above the tumor mass, which extends well into the liver substance. The tumor is relatively small with

no signs of metastasis; the usual signs of malignancy are absent, the symptoms being due to the strategic location of the tumor producing the signs of an obstructive jaundice.

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CAUTERY-PNEUMECTOMY

The technic of cautery-pneumectomy, described by Dr. Evarts A. Graham, in the ANNALS OF SURGERY of August, 1927, p. 178, appears to be identical with that of the operation devised by Professor Gluck, and performed by another surgeon at Professor Gluck's suggestion, nineteen years ago. The operation was performed for threatened asphyxia, caused by compression of the trachea by a mediastinal tumor. The operation demonstrated the possibility of retrograde respiration. Professor Gluck, writing from Berlin, November 15, 1908, kindly gave me the following details:

Two or three ribs (sixth to eighth) are resected in the posterior axillary line. The two layers of pleura are sutured together, inclosing an area of lung surface the size of a man's hand. A fortnight later, or at once if the case is urgent, the lung is burned away with a cautery, until the opened ends of a number of the smaller bronchi are exposed in the cauterized surface. The cauterization may be made sufficiently deep to expose the larger bronchi, but this is not necessary.

The operation may be repeated on the opposite lung, if required. The aims of the two operations differ, that of Professor Gluck's being to let air in, that of Doctor Graham's to let pus out.

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BOOK REVIEW

TESTIMONIAL TO DR. RAFFAELE BASTIANELLI, of Rome, Italy, by his pupils and friends on the 25th anniversary of his Professorship in Surgery. A collection of surgical articles written in honor of Dr. Raffaele Bastianelli, published in the Italian Archives of Surgery, in its XVIII Volume (1927). The contributions are from one hundred and five Italian physicians and surgeons, some of them old pupils of Professor Bastianelli, the rest old friends and admirers, beside twenty-five more friends and admirers from foreign countries.

The volume is of over 700 pages. It is perhaps the first time that an international work of this kind is done in honor of a man, who, being well known and popular through the professional world, fully deserves it for his constant and valuable contributions to the progress of surgery.

Most interesting are the articles of F. H. Albee on "Extra-articular Arthrodesis in Tuberculosis of the Spinal Vertebræ, of the Hip-joint and the Sacro-iliac Joint." That of W. J. Mayo on "Surgical Diseases of the Spleen"; that of E. Starr Judd on "Cholecystitis"; that of E. Beer on "Clinical and Pathological Analogy between the Urinary and the Biliary Tract"; that of J. C. Bloodgood on "Duodenal, Acute and Chronic Dilatation, and the Gastro-enteric Ileum" and Vincent Gaudiani on "How to Deal with the Ureter in Its Extravesical Insertion."

Among other contributions of foreigners is one from Sir Berkeley Moynihan, of England, on "Perforations of Gastric and Duodenal Ulcers"; one of V. Pauchet, of France, on "How to Treat Gastro-intestinal Hemorrhage" and "Excision of the Ulcer and Cæcostomy"; one of R. Leriche on the "Section of Communicating Branches in Painful Manifestations of the Limbs"; one of P. Duval on the "Part Played by Infection in the Evolution of Some Gastro-duodenal Ulcers and Its Therapeutic Indications". The volume, beside its commendable purpose of a testimonial to Dr. Raffaele Bastianelli, is also a very valuable contribution to the scientific and practical progress of medicine and surgery.

PAOLO DE VECCHI.

EDITORIAL ADDRESS

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